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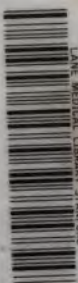
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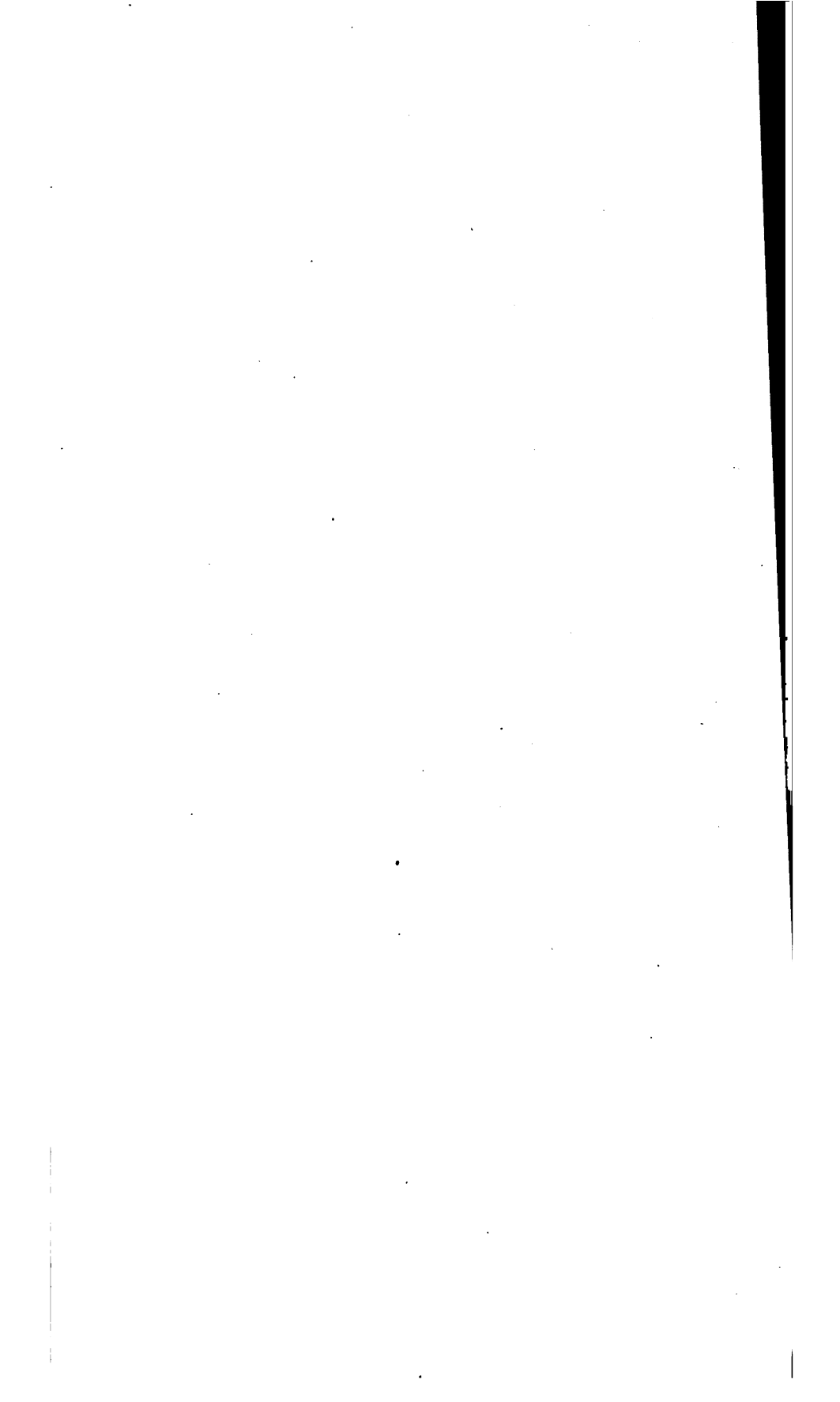
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A

HAND-BOOK OF OPERATIVE SURGERY.

BY

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WITH

FIFTY-FOUR STEEL PLATES AND NUMEROUS ILLUSTRATIONS ON WOOD.



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PREFACE.

THE following pages are intended to serve as a hand-book, in which the practitioner, whether of recent or of long standing, may find clear and succinct directions for whatever operation he may be called upon, in the ordinary course of his duties, to perform. With this view, the great aim of the author, next to accuracy, has been conciseness.

It will readily be seen that in such a work there is no room for the discussion of symptoms, diagnosis or general treatment, except so far as they should influence the adoption or the choice of operative measures. How far the author has succeeded in his attempt to produce a practical guide, omitting nothing which would be to the purpose, and introducing nothing foreign to it, the profession must judge.

The directions given have been, in almost every instance, based upon the experience of the author, in hospital and private practice, and in the dissecting-room, together with his observation of operations done by others. Comparison with standard works previously issued has been resorted to, in order to insure greater correctness.

Cases vary so much, in more or less important respects, that it would be impossible to give, within any reasonable

compass, rules for operating which should leave nothing to be suggested by the tact and ingenuity of the surgeon; to say nothing of the presumption of such an undertaking. But it is believed that those who consult the volume now offered to the profession will find in it at least one good method, practically described, for every surgical operation in general use at the present day.

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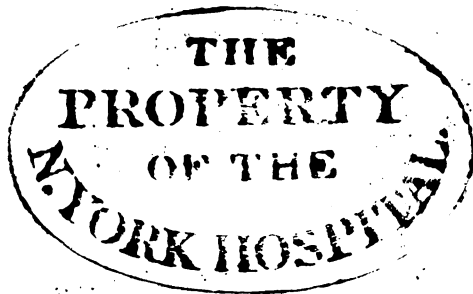
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OPERATIVE SURGERY.

CHAPTER I.

GENERAL REMARKS IN REGARD TO SURGICAL OPERATIONS.

SURGICAL OPERATIONS must sometimes be done on the instant, from urgent necessity; as for example when a foreign body is impacted in the trachea, and an opening must be made into that tube. Even here, however, the surgeon should act coolly and with presence of mind,—rapidly but not hurriedly.

When there is no such urgency in the case, all the arrangements should be deliberately made, and all the precautions adopted, which may tend to insure the greatest degree of success.

Much depends upon the surroundings of the patient. These should be as cheerful as possible, without excitement. A well-ventilated room and proper diet are always essential, and in many cases trained attendants must be secured. In hospital practice these things ought to be matters of course; in private the surgeon must see to them in each instance.

When the case is one of injury, a careful inquiry should be made as to the existence of other lesions; thus, it would be useless to amputate an arm or leg for compound fracture, if the patient were suffering also from laceration of the brain-substance, or from rupture of the liver. The same is true of disease; it would be folly to remove a cancerous testis, if the lumbar glands were already involved.

The probability of success in an operation is much lessened by morbid constitutional states, such as typhoid fever, syphilis, or phthisis; by nervous disorders, such as chorea, epilepsy, or delirium tremens; or by disease of important organs, such as diabetes, or fatty liver. Excessive timidity in the patient is sometimes an adverse condition.

A thorough knowledge of the anatomy of the part to be operated on is essential to scientific surgery; and where deviations from the normal arrangement of the parts are likely to exist, these must be taken into account.

The best time for operating is in clear weather, with an ascending barometer,* and with the temperature neither very high nor very low.

After-treatment.—Very much of the success of operative surgery depends upon the degree of judgment exercised in the subsequent management of cases. Sometimes we must stimulate by means of quinine, wine-whey, milk-punch, egg and brandy, or beef tea, and sometimes we must instead of these give diaphoretics, purgatives, etc. Sometimes both plans must be combined,—secretion being promoted at the same time that nourishment is given in a concentrated form. General rules cannot be laid down in this matter; the surgeon must use his discretion in each case.

When an operation, or the injury necessitating it, has been attended with much loss of blood, the wine or the fluid extract of ergot may be given to great advantage; it seems to contract the entire arterial system, and accommodate it to the lessened bulk of the blood. The dose of the wine is fʒss, of the fluid extract fʒj, every four or six hours.

Arrangements.—Before commencing an operation the surgeon should run over in his mind the steps of which it will consist, and see that all the instruments he will require are at hand, in good condition, and arranged in order. He should assign to each assistant his duty, giving all needful explanations as to the procedure to be instituted. No operator is so skilful that he may not be baffled, perhaps at a critical moment, by awkwardness or blundering on the part of a helper; and, therefore, every precaution should be taken to enable all to work together to the best advantage. The duties assigned to each one should be strictly adhered to, unless in the case of some extraordinary and unforeseen emergency, demanding instant action.

Operating-table.—For most operations a table about as wide and long as an ordinary single bedstead, and about as high as a dining-table, is best; a firm and even mattress laid upon it will give it just the right height. It should be so placed that

* See Dr. A. Hewson's Paper in the "Pennsylvania Hospital Reports" for 1869.

the light will fall upon it properly, and that another table or stand for the instruments may be put within easy reach of either the operator or one of his assistants.

When a child not over ten or twelve years of age is to be operated upon, it is often more convenient to have it held in the lap of a strong assistant than lying upon a table. The child should first be wrapped in a sheet or table-cloth, confining both the upper and lower extremities; the assistant then takes it upon his knee, clasping his arms around it, and controlling the lower extremities with his other leg. Another assistant may now administer the anæsthetic.

Complete insensibility having been induced, the part to be operated on may be exposed, the surgeon sitting in another chair, kneeling or standing, as the case may be.

Temperature of room.—The temperature of the room must be carefully regulated. No capital operation can be safely performed in any place where the mercury is below 65° Fahrenheit, especially when large joints or other cavities are opened into. This is a matter which is often neglected, to the great disadvantage of patients. •

Appliances.—Besides the instruments, an abundant supply of ligatures, or acupressure needles and wires, suture-needles properly threaded, adhesive plaster cut into strips, lint, styptics, one or two tourniquets, a door-key, with its handle well wrapped, should be placed in readiness. Well-boiled sponges, soft but of firm texture, about half as large as the closed fist, are invaluable in all surgical operations.

The part to be operated on should always be shaved, if hairy.

Anæsthesia.—The anæsthetics in general use at present are sulphuric ether, chloroform, and nitrous oxide. Ether is the safest; but sometimes we have to use chloroform, as in operations about the face, when the actual cautery must be applied, or at night, when artificial lights are needed, and the ether might take fire. Nitrous oxide can only be effectively employed when the operation is one which occupies but a few seconds, such as the extraction of teeth.

When ether is given, the great object is to have the patient inhale its vapor, without any admixture of atmospheric air. Hence the best plan is to use a cone of sufficient size, made of a stiff towel, or of sponge cut into suitable shape. The deside-

ratum is surface for evaporation. The cone may be about eight inches in height, and wide enough at its base to cover the nose and mouth. A small quantity of ether is dashed into it, and it is immediately applied over the patient's face, the head being held steady between the hands, while the thumbs keep the cone in position. The struggles of the patient must be restrained by assistants. Fresh ether must be dashed into the cone from time to time.

For the reduction of dislocations, for the opening of abscesses, or for almost any operation which requires but a very short time, we may take advantage of the earliest insensibility, which comes on a very few minutes after inhalation, and soon gives way to the stage of excitement.

In giving chloroform, the danger is much lessened by allowing some air to enter the lungs along with it. A very good method is to lay a single thickness of thin stuff, such as an old pocket-handkerchief, over the mouth and nose of the patient, and then to let the chloroform fall on this drop by drop, quickly, from the bottle. The nostrils and lips must be previously greased to prevent irritation.

Nitrous oxide is usually given, in cities, by persons who are in the habit of using it for dental operations. As a special apparatus is required, it can scarcely come into general use in any but large towns.

Local anæsthesia, by ether spray or by freezing mixtures, has not answered the expectations of its advocates, except for very small operations.

Incisions.—There are various modes of making incisions, according to the nature of the operation to be done, and especially according to the thickness of the skin or other tissue divided, and the anatomy of the underlying structures.

The knife may be held like a fiddle-bow, as in Pl. I, Figs. 1, 2, 3, 4, and 7, or like a pen, as in Figs. 5 and 6. It may be made to cut from without inward, or be pushed through the tissues, and then made to cut its way out, or from within outward. When important structures lie just beneath the skin, this latter may be pinched up, and cut in either of the ways just mentioned: from without inward, as in Fig. 2, from within outward, as in Fig. 4.

Often it is of advantage to use the left hand, to put on the stretch the portion of skin about to be divided, as in Fig. 3.

Plate I.

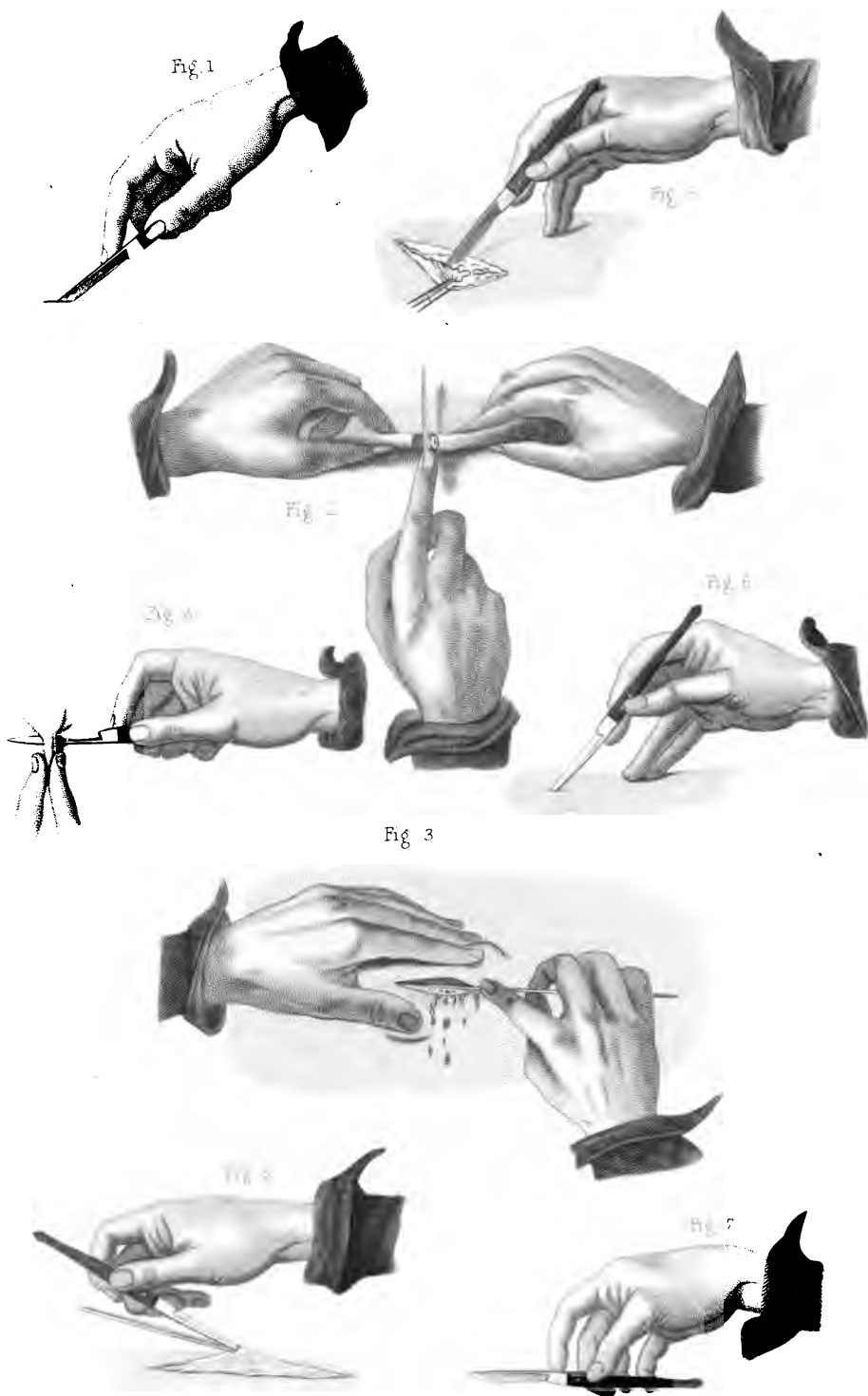


Fig 1

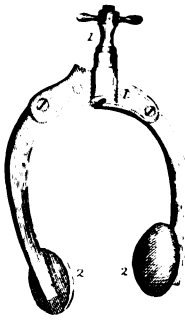


Fig 2



Fig 3

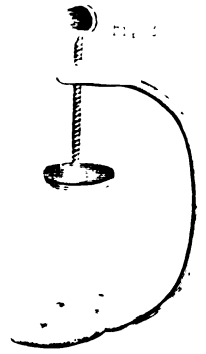


Fig 3



Fig 10.

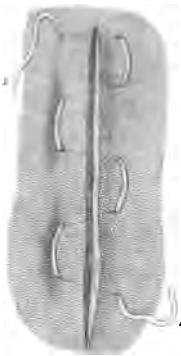


Fig 9

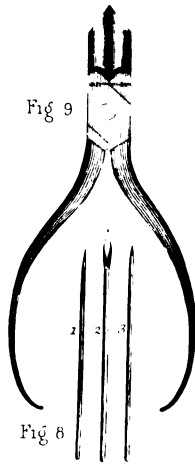


Fig 11

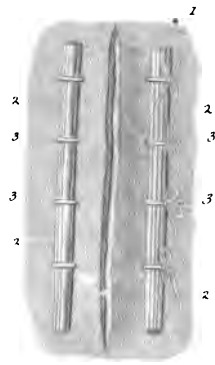


Fig 8

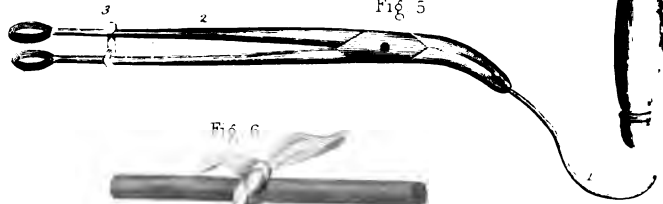


Fig 5

Fig 6



Fig 12.

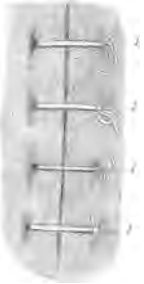
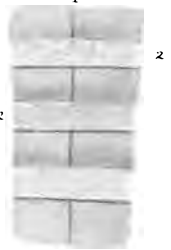


Fig 13



When, as in operations for strangulated hernia, or for the ligation of arteries, successive layers of tissues must be divided, it is best to pinch up each layer with forceps, nick it, and then to push under it a grooved director, along which, its back downward, as in Fig. 8, the knife can be safely insinuated.

Sometimes the director is not necessary; the layers being simply pinched up with forceps, put on the stretch, and divided, as in Fig. 5.

Different forms of incisions are shown in Fig. 7, Pl. II. When one flap only need be turned up, it may be marked out by two cuts, as at 1. Two flaps may be made by a T-shaped cut, as at 2; a rectangular flap by three lines, as at 3, or two rectangular flaps by three incisions making an H, as at 4. By means of two cuts crossing one another at right angles, as at 5, four flaps may be turned up, so as to expose the deeper structures. A semilunar incision, as at 6, will sometimes answer very well, giving a good deal of room, and being easily closed; this may sometimes be repeated so as to make an S, or, as at 7, to take out an elliptical portion of skin.

Sometimes two incisions are to be made. In that case it is almost always better to make the lower one first, so that the flow of blood from the upper one may not interfere with it.

Control of hemorrhage.—When copious hemorrhage occurs upon the division of the skin, if the blood is bright red, and jets out with each pulsation of the heart, the wounded vessel is an artery, and should be tied. But if the blood is dark, and wells out continuously, it comes from a vein, and will probably cease in a few moments. Should general oozing occur from a wounded surface, it may be exposed to the air, or washed either with cold water, alcohol, or some stronger styptic. Or a piece of ice may be rubbed over it. Still another plan is to use the actual cautery,—a shaft of iron, having an extremity either olive-shaped, as in Fig. 3, Pl. II, or button-shaped, as in Fig. 4, and set in a wooden handle. This may be applied, either at a black or red heat, to the oozing surface.

Prevention of hemorrhage.—Before beginning any operation likely to be attended with hemorrhage, the flow of blood to the part must be in some way controlled. If the part concerned is in the trunk, pressure with the fingers of an assistant may be resorted to; if in an extremity, some form of tourniquet or arterial compressor may be employed.

Fig. 1, Pl. II, shows Signoroni's tourniquet, the screw, 1, regulating the degrees of approximation of the pads, 2, 2.

In Fig. 2 is represented Bellingham's, the large lower pad being put beneath the limb, and the upper one forced down upon the vessel by turning the screw.

When neither one of these compressors nor the ordinary tourniquet (Fig. 6, Pl. III) is at hand, a rough substitute may be made in the shape of the "Spanish windlass," Fig. 6, Pl. II. A handkerchief is tied around the limb, and twisted with a stick until the requisite pressure is exerted on the vessel. One end of the stick is then either thrust under the handkerchief, or fastened to it, so as to prevent untwisting.

The regular tourniquet (known also as Petit's) is put on as follows: a roller is applied around the limb by two or three turns; the remainder of it, brought just over the artery, is then used as a compress, the band being buckled on, the bridge screwed down, and adjusted over the vessel. By turning the screw, the band is tightened, and the current of blood checked in the artery. (Fig. 6, Pl. III.)

Still another plan is for a reliable assistant to grasp the limb, and make pressure on the vessel either with his thumbs, as in Pl. III, Fig. 7, or with his four fingers. The tourniquet is much safer.

Closure of wounds after operations.—For the closure of wounds, there are various plans. The glover's, or continuous suture, shown at Fig. 10, Pl. II, is now not much used. In some operations, where we want to insure union between the deeper structures, the quilled suture, Fig. 11, is better than any other. This is made by passing double threads through the edges of the wound, with an ordinary needle; a small roll of lint, a quill, or a bit of bougie, is now passed through the loops on one side, and another placed between the double row of ends on the other side; and by tying these ends as firmly as may be required, we bring the quills toward one another, and press the edges of the wound together. Ordinarily, however, we use either the interrupted suture, Fig. 12, or the harelip suture, with pins such as are seen in Fig. 8. The suture itself is shown in Pl. III, Fig. 10.

In making the harelip suture, the pins are pushed through both lips of the wound, about a quarter of an inch from their edges, as at A, Pl. III, Fig. 10. All the pins being in place, a

piece of silken or hempen thread is passed in figure-of-8 turns, as at B, around each pin, so as to crowd the cut edges together. When the suture is completed, the sharp points of the pins are nipped off with the cutting pliers, Pl. II, Fig. 9; the skin is then protected from injury from the pressure of the pins, by putting a strip of adhesive plaster under each row of ends, as at B, Pl. III, Fig. 10.

In order to pass the suture needles readily, the forceps, such as are shown in Pl. II, Fig. 5, were devised by the late Dr. Physick; the needle being grasped, the catch, 3, on the handle is secured, so as to make but one instrument of the needle and forceps.

A plan which I always use in making the interrupted suture with metallic wire, is to employ a needle with an eye near the point, set in a handle or grasped in forceps. Pushing this needle through both lips of the wound, I pass the tip of the wire through the eye of the needle, and pulling the latter back, it draws the wire after it. By this method I entirely avoid the kinking of the wire which is apt to take place when common needles are used.

One of the usual shapes of suture needles for silken or hempen thread is shown in Fig. 8, Pl. III; another form, curved only near the point, may be seen in Fig. 9. It is always necessary that these needles should not only be sharp at their points, but should have a cutting edge at either side, extending as far as their broadest part; otherwise they will not readily make their way through the skin.

Arrest of hemorrhage.—Mention has already been made of the controlling of hemorrhage by the tourniquet, the Spanish windlass, etc. After an operation (such as the removal of a limb) is over, we must make some arrangement for the permanent prevention of the bleeding; and the plan generally adopted is to tie the vessels which have been divided. In

Fig. 1.



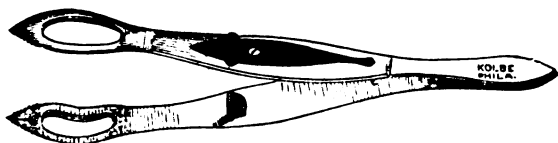
order to do this, we draw them out and isolate them, either with a tenaculum or hook, Fig. 1, or with a pair of forceps;

the forceps should either close with a spring, Fig. 2, or have a slide to hold the blades together, as in Fig. 3.

Fig. 2.



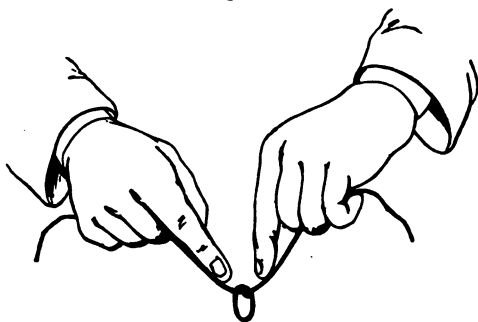
Fig. 3.



In whatever way the artery is isolated, its ligation is effected by tying tightly around it a thread of saddler's silk, or of hemp, so as to thoroughly occlude it. Some surgeons, and especially Mr. Lister, of Edinburgh, steep their ligatures in a strong solution of carbolic acid, thinking that the antiseptic properties of this substance lessen the risk of pyæmia.

An ordinary flat double knot is tied in the thread, and one end is cut off short; in large amputations, it is better to leave both ends of the ligature on the main artery, knotting them together so that it may be distinguished from those on the smaller vessels. The mode of tying the knot, especially where the vessel lies deeply, by pushing it down with the fingers, is shown in Fig. 4.

Fig. 4.



As the effect of the ligature applied in this class of cases is the same as where an artery is cut down upon and tied, it may not be out of place to describe it here once for all. The inner and middle coats of the vessel are cut across by the pressure,

Plate III.

Fig. 2.



Fig. 1.

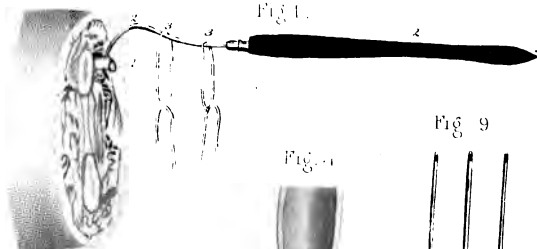


Fig. 3.

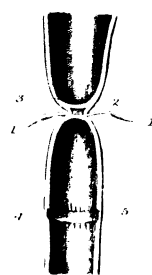


Fig. 9.



Fig. 4.



Fig. 8.



Fig. 7.



Fig. 6.



Fig. 10.

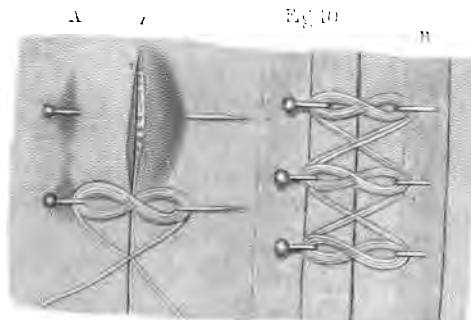
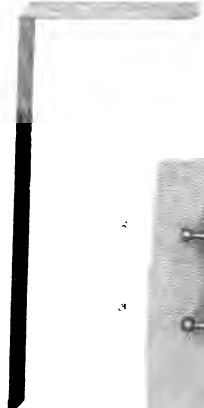


Fig. 12.



Pl. III, Fig. 3,—4, 5, wrinkled up, and contracted. A clot forms between the seat of compression and the nearest branch given off between it and the heart, as seen in Pl. III, Fig. 4; 1, the branch, 2, the tapering clot. The artery shrinks and becomes a mere fibrous cord at the part ligated. (Pl. III, Fig. 2.)

Fig. 5, Pl. III, illustrates a most important point. When an artery is tied in its course, the part to which it conveys blood would become gangrenous if it were not that other channels take the place of that which is closed; or, in surgical phrase, the collateral circulation becomes established. Thus in Fig. 5, the femoral artery, 1, has been tied at A, for a popliteal aneurism, 2. All the branches which arise from the femoral above the point of ligation are enlarged and tortuous, 3, 3, 3, 3, and carry to the popliteal, at and below the point, B, at which it becomes pervious, the blood which is needed for the leg and foot.

Another plan for occluding vessels after operation or injury, is that of acupressure, proposed by Prof. Sir J. Y. Simpson, of Edinburgh. There are four ways of doing this. (1) In the case, for example, of amputation of the thigh, a long needle is entered through the skin of the flap containing the femoral artery, and brought out on the cut surface; then, by depressing the head of the needle, it is made to bridge over the vessel, passed back into the cut surface, and brought out again externally; thus exerting a pressure against the vessels like that which we make when we apply a pin so as to keep the stalk of a flower against the lapel of the coat. (2) A short common sewing needle, threaded with fine iron wire, is passed into the cut surface at one side of the vessel, and at a little distance from it; it is made to dip into the tissues so as to get something of a hold on them, and is then brought out close to the vessel, made to bridge it across with some pressure, pushed into the cut surface again, and again brought out, still on the cut surface. The wire is for the withdrawal of the needle. (3) A common sewing needle, threaded as before, is passed into the tissues of the cut surface, and brought out again, so that the middle of the buried part is close to the artery. Now a loop of fine iron wire is slipped over the tip of the needle, carried across the vessel just above its open mouth, pulled tight enough to close it, and secured either by tying or twisting around the other portion of the needle. In about forty-eight hours, the wire attached to the needle, which should be twisted so as to mark it, may be pulled

upon, and the needle withdrawn, when the other or looped wire will of course be free. (4) The needle, threaded as before, is thrust through the vessel, turned around so as to twist the vessel on itself, and then pushed into the tissues so as to engage it, and prevent its rotating back again.—Of these four methods, which may be readily understood by practising them on the dead body by the directions just given, the third is the one which has found the most general favor. The pressure by either may be removed in from forty-eight to seventy-two hours.*

Still another method of securing a divided artery is that by twisting or torsion. This is generally done by means of two pair of forceps; with one the artery, drawn out to about one-eighth or one-quarter of an inch from the surrounding tissues, is caught close to the latter, while with the other pair the free end is seized and rotated so as to twist it up and bring its sides into close contact.

This method, although it has been applied to large vessels, and successfully, is not so safe as either ligation or acupressure. We may often, however, permanently check the flow of blood from small arteries by just catching them as they spring and giving them a sharp twist: occasionally the same object is gained by mere pinching. The danger in either plan is, that after the wound is dressed and the patient put to bed, the circulation becoming more active, the blood may again flow in such quantity as at least to interfere with the healing.

* Full descriptions of these methods, with illustrative cuts, may be found in the works on acupressure, published by Sir J. Y. Simpson, and by Pirrie and Keith.





CHAPTER II.

OPERATIONS ON THE HEAD AND NECK.

§ I. TREPHINING.

THE operation of trephining is sometimes called for in fractures of the skull, when a portion of the bone is depressed, and the symptoms indicate that there is pressure made upon the brain-substance. (The symptoms of *compression*,—coma, or convulsions, or both, with irregularity of the pupils, etc., are fully described in works on surgery.) Occasionally it has been done to give exit to blood or pus effused within the cranium, and it is sometimes resorted to in cases of old injury, or of disease, as epilepsy; but it is unjustifiable unless the point of pressure can be clearly made out.

Surgical Anatomy.—The vault of the cranium is composed of flat bones, united by sutures, and consisting of two tables, an outer and an inner; between these tables is a cancellous layer, amply supplied with veins, and called the diploë. In young persons this diploë can hardly be distinguished.

There are certain regions in which, from the large blood-vessels that exist within the skull, the operation of trephining is more dangerous than elsewhere. In Fig. 1, Pl. IV, these vessels are shown. Along the median line, from before backward, runs the great longitudinal sinus, 1, 1, 1, 1, carrying venous blood. From the occipital protuberance, at the back of the head, runs the lateral sinus, 2, 2, also carrying venous blood, and going to empty into the internal jugular vein. 3, the anterior branch of the middle meningeal artery; 4, its posterior branch; 5, the surface of the dura mater.

Operation.—Fig. 2, Pl. IV, shows the scalp freely dissected down so as to expose a stellate fracture of the skull, with some

Fig. 5.



depression. If in such a case there were symptoms of compression of the brain, the trephine should be applied at the point of depression, and if necessary the depressed portions of bone pried up with an elevator, Fig. 5.

The instruments needful are: scalpels, a lenticular knife, Fig. 6, large and small trephine, the best pattern being the conical,

Fig. 6.



Fig. 7.

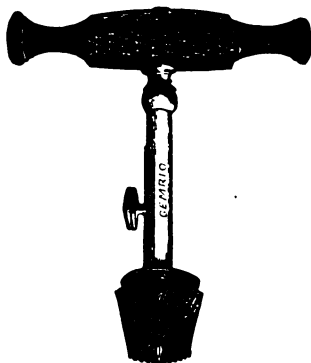


Fig. 8.



Fig. 7, tenaculum, artery forceps, etc. A small brush to clean the trephine, Fig. 8, and a quill sharpened in toothpick form, to clear the groove made in the bone, should be at hand.

Anæsthetics may often be dispensed with, the patient being already insensible. Should he be uneasy, and struggle, assistants must hold his hands, and keep him from interfering with the surgeon.

When there is a wound of the scalp, communicating with a fracture, it may have to be enlarged so as to give free access to the latter. If there is no wound, the bone may be laid bare by an incision, generally either crucial or V-shaped, the fibrous tissues being also divided and turned back with the lenticular knife. The precise spot being exposed, at which the depression exists, the surgeon applies the crown or circular edge of the trephine, the central point being pushed out about one-eighth of an inch, and works it like an awl, rotating it back and forth, but making no pressure. (Pl. IV, Fig. 3.) From time to time he takes it away and clears out the groove with the quill, at the same time testing its depth. As soon as the groove is deep enough to hold the instrument steady, the central point is pushed back, lest the *dura mater* should be wounded by it. Upon the cessation of resistance, indicating the complete penetration of the bone, the instrument is withdrawn, and the button of bone extracted either with forceps, with a small gimlet-like screw engaged in it, or with an elevator. (Fig. 5.) When there is

fracture, it may be necessary to pry up one or more of the fragments with the elevator, or to extract a piece loosened by the section already made. If the compression has been due to pus or blood effused within the cranial cavity, outside of the dura mater, the removal of the button of bone may suffice; or if the dura mater bulges up into the trephine-hole, a small incision into it may be required. The less interference with the tissues, the better, provided only that the pressure on the brain be relieved.

Any vessels that spring may be tied, or pinched in a pair of forceps, or twisted.

In closing the wound, it is better as a general rule to employ adhesive strips, and to avoid the use of sutures, since erysipelas is readily excited by irritation of the scalp.

§II. OPERATIONS UPON THE EYE AND ITS APPENDAGES.

For operations upon the eyelids and parts outside the eyeball, the patient is usually placed in a state of anæsthesia; in cases of children, indeed, this is often indispensable, since their crying and struggles, and the strong contraction of the orbicular muscle, would otherwise render the surgeon's procedures not only difficult but uncertain.

As in nearly all operations on the face, the position of the patient may vary. He may sit in a chair, his head resting either against the breast of the surgeon standing behind him, or against that of an assistant, the surgeon sitting or standing in front. Or he may lie on a firm bed or table, his head on a pillow, and the surgeon standing either at the back of the head or at the side of the bed or table. If the surgeon is equally expert with either hand, he can operate on both eyes, whether from above or in front, without changing position; but if he uses his right hand mainly, he will operate on the right eye from above, and on the left from in front.

In doing plastic operations on the lids, the surgeon generally faces the patient, whether the latter is lying down or sitting up, since he can judge better as to the effect of what he does.

(1) OPERATIONS UPON THE EYELIDS.

Surgical Anatomy.—Each eyelid contains a plate of fibro-cartilage, covered externally by skin, internally by mucous membrane continuous with the con-

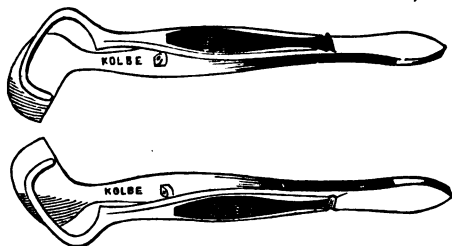
conjunctiva. Between these tarsal or palpebral cartilages and the skin, is a muscular layer, the orbicularis palpebrarum, which by its contraction closes the lids. The cartilage of the upper lid has attached to its upper edge a muscle, the levator palpebræ, which draws it up and opens the eye.

At the edge of each lid is a row of follicles from which spring the eyelashes, and behind the cartilage, between it and the conjunctiva, is a corresponding row of tubular sebaceous glands, called Meibomian.

Between the cartilages and the orbicularis muscle there is a fibrous layer, the tarsal ligament, attaching the outer margin of the cartilages to the rim of the orbit. This membrane is particularly strong externally, where it is called the external tarsal ligament, and internally, where it is called the tendo oculi.

Removal of tumors.—Small rounded encysted or fibrous tumors are not uncommon in the subcutaneous or submucous tissue of the lids. When under the skin, they may be excised, in the manner shown in Fig. 1, Pl. VI. The lid is fixed by grasping it steadily in the forceps of Desmarres (see Pl. V, Fig. 3), the solid blade being passed behind it, and the fenestrated one in front, surrounding and making prominent the tumor; which is then dissected away with a delicate scalpel and forceps, the incisions being made *along* the lid. Another form of these forceps, devised by Snellen, is shown in Fig. 9. They are more convenient, because the edge of the lid is left free; the blades are set at an angle, so that they may be used for the right or left eye.

Fig. 9.



A convenient mode of dealing with these tumors, when seated under the mucous lining of the lid, is shown in Fig. 2, Pl. VI. An assistant everts the lid over the slender handle of an eye-instrument, 2, holding it tense with 1, Desmarres' bifurcated forceps (see Pl. V, Fig. 1); the surgeon then uses a fine forceps, 3, and bistoury, 4, to remove the tumor.

Ptosis, or falling of the upper eyelid, may sometimes be remedied by the operation shown in Fig. 3, Pl. VI. A fold of the skin of the lid, 2, is pinched up with the forceps, 1, and

Plate V.

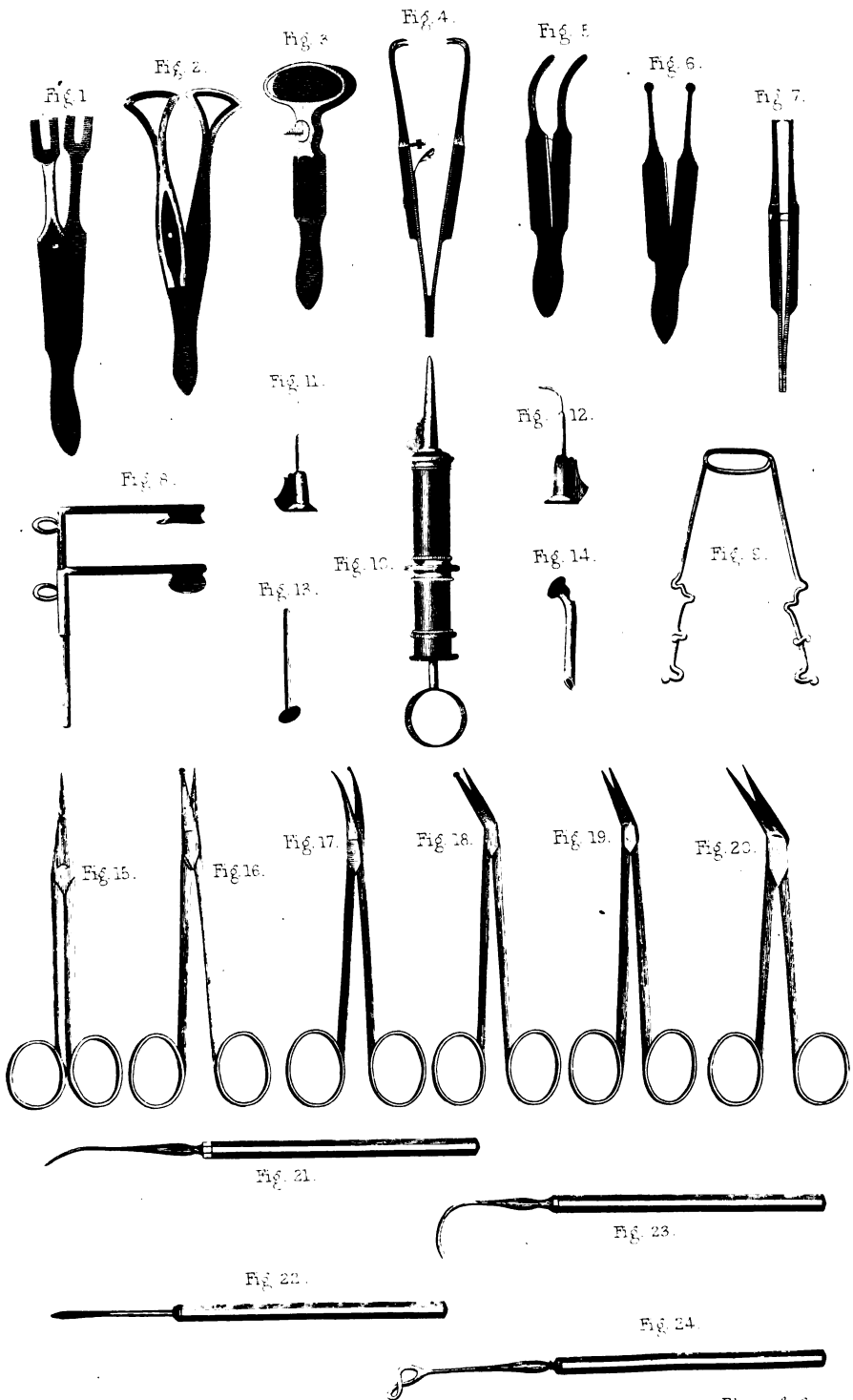




Fig. 6.



Fig. 8.

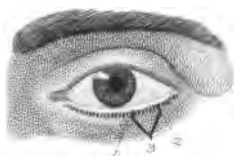


Fig. 10.



Fig. 12.

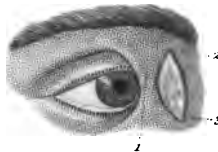


Fig. 14.

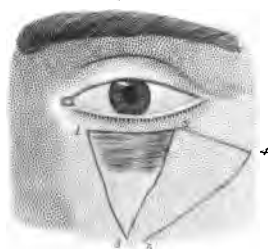
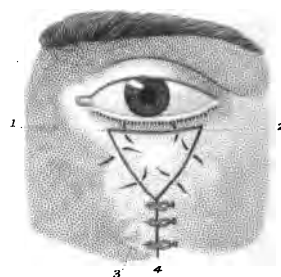


Fig. 16.



snipped away with the scissors, 3. (The operation is more likely to succeed, if done much closer to the free edge of the lid than is represented here.)

Another operation for ptosis, that of Hunt, of Manchester, is shown in Figs. 4 and 5, Pl. VI. The eyebrow being shaved off, the skin just at its lower edge is removed by two elliptical incisions, as in Fig. 4; the lips of the wound are then brought together with three or four fine harelip sutures, as in Fig. 5, with the effect of pulling up the upper lid.

Ectropion, or eversion, is usually met with in the lower lid, in reference to which the operations for it are therefore generally described; but the same procedures, with but slight modifications, are suitable for the upper.

The operation of Weller, a very simple one, is shown in Fig. 6, Pl. VI. An assistant everting completely the lower lid, the surgeon lays bare the cartilage by an incision through the mucous membrane, and drawing it out with forceps, 1, snips away a portion of it with fine scissors, 2.

When the lid is adherent to the ball (*symblepharon*) to a very small extent, it may sometimes be dissected away, and prevented from becoming again attached by keeping a small silver plate interposed until the healing is complete. Or, as advised by Von Ammon, a V-shaped incision may be made around the adhesion, as in Fig. 7, Pl. VI; the edges 1—3 and 2—3 are then brought together, and united by a fine harelip suture including the whole thickness of the lid, as in Fig. 8.

Sometimes, after injury or the removal of a tumor, there is a loss of substance in the skin of the lower eyelid, causing ectropion. To remedy this, Dieffenbach advised making an incision through the skin outward from 2 to 4 (Fig. 9, Pl. VI), and another downward and inward from 4 to 5; the flap thus defined being then loosened from the tissues beneath, may be shifted over so that the edge 3—2 shall correspond to 3—1, and fastened thus by sutures.

Another mode of transplantation is that of Wharton Jones, represented in Fig. 10. A triangular flap of suitable size is marked out by incisions through the skin of the cheek just below the spot to be covered; the surface of the latter is then freshened, the flap, when partially dissected from the subjacent tissues, especially towards its apex, is by gentle traction brought up into the desired position, and secured by a sufficient number

of points of suture. Finally, the edges of the gap left below are approximated by harelip sutures, as at 4.

The operation devised by the late Dr. Horner, in a case of loss of substance by a burn, is seen in Pl. VII, Figs. 8 and 9. The first incision, from 1 to 2, frees the edge of the lid; the second, 3 to 4, an inch long, runs downward and outward; while the third, 4 to 5, runs inward towards the tip of the nose. On dissecting up these flaps, and shifting them so as to place 3, 4, 5 above 1, 3, 4, it will be seen that the lid will be raised into its place.

Another operation for loss of substance from a like cause, that of Brainard, is shown in Fig. 10, Pl. VII; it corresponds to that for the upper lid in Fig. 1. The lid being freed, and the surface freshened, a flap is detached from the skin at the outer edge of the orbit, twisted round, and fastened in place by sutures.

Another operation for ectropion, that of Adams, is seen in Pl. VII, Fig. 3. An incision is made, as at 1, through all the tissues of the lid; the edge is then grasped with forceps, 2, and another incision made in like manner with the scissors, 3, joining the first, and detaching a triangular segment of the lid. The two cut edges left are now sewed together.

When the ectropion is due to a cicatrix in the skin of the lower lid, Dieffenbach's plan may be followed, as shown in Pl. VII, Fig. 4. He included the cicatrix in a triangular incision, the base of the triangle above, the apex below. Then, extending the base-line either way, he brought the sides together by sutures; thus closing the wound, freeing the skin above, and pushing the lid into place.

Desmarres' operation is rather more complex. (Figs. 5 and 6, Pl. VII.) He divides the tissues at the outer canthus by an incision, 1—2. (Fig. 5.) Another, from 2 to 3, includes a sufficient portion of the lower lid. Two more cuts, from 1 to 4 and from 3 to 4, separate a segment of the lid. By bringing up the edges with harelip sutures, as in Fig. 6, the tissues are so tightened as to draw the lid into its proper plane.

When a portion of the upper lid is lost, as by injury, it may be necessary to make it up by transplanting a flap of skin from the outer side of the orbit. Fig. 1, Pl. VII, shows the surface to be covered, 1, 2, 3, 4; the flap marked out, 3, 5, 6. In Fig. 2 the flap is seen twisted round into its new position, and

Plate VII.

Fig. 1.

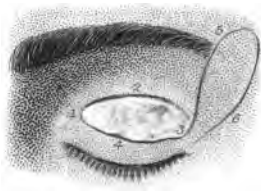


Fig. 2.

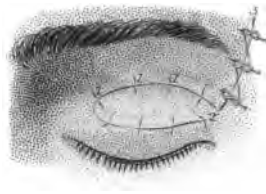


Fig. 8.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 9.

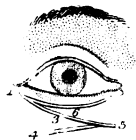


Fig. 6.



Fig. 7.

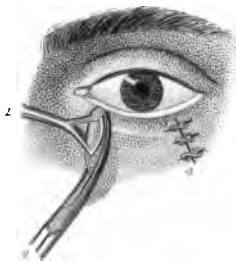
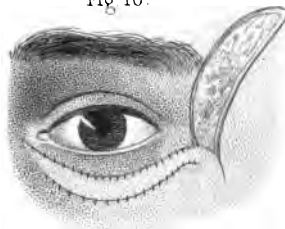


Fig. 10.



fastened by sutures, 1, 1, 1; the edges of the gap left by it are brought together with fine harelip sutures.

Epicanthis is the name given to a crescentic fold of skin sometimes present in children, covering the inner canthus. If it does not disappear with the full development of the nose, an elliptical portion of skin may be excised as in Fig. 11, Pl. VI, and the gap closed by sutures.

Entropium.—When the lower lid is inverted, we have the condition of *entropium*. For this, Jansen's operation is shown in Fig. 7, Pl. VII. The object is to tighten the fold of skin, by removing two portions of it, one near the outer and the other near the inner angle. A fold being pinched up with forceps, 1, is snipped out with curved scissors, 2, and the edges brought together with harelip sutures, so as to make the wound linear instead of elliptical; in the manner shown at 3—4.

Some surgeons prefer pinching up the fold of skin, in cases of entropium, with a pair of forceps (Fig. 10), and shaving it off

Fig. 10.



closely. Dr. Morton's forceps for this purpose (Fig. 11) have

Fig. 11.



a sliding knife, which is pushed forward after the fold of skin is grasped, and thus cut it with perhaps greater accuracy.

(2) OPERATIONS UPON THE LACHRYMAL APPARATUS.

Surgical Anatomy.—The lachrymal gland, Pl. VIII, Fig. 1, 1, is situated at the upper and outer part of the orbit. At the inner angle of the eye, the upper canaliculus, 2, and the lower, 3, empty together into the lachrymal sac, or upper part of the lachrymal canal or ductus ad nasum, which, by the removal of the os unguis and anterior part of the left superior maxillary bone, is exposed, and is represented as laid open.

Probing and division of the puncta and canaliculi.—Fig. 2, Pl. VIII, exhibits the mode of introducing a probe through the upper punctum. The patient may sit in a chair, his head rest-

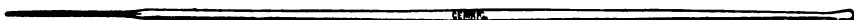
ing on the chest of the surgeon standing behind him; or he may lie on a steady table, his head on a firm pillow. A delicate probe is entered at the punctum, and carried inward along the canaliculus, till it reaches the lachrymal sac; the outer angle of the eyelids is drawn upon so as to render all the parts tense. If now the handle of the probe is elevated, the point will take the course of the dotted line, and emerge in the inferior meatus of the nose, just behind the anterior end of the lower turbinated bone. (A probe can be introduced in the reverse direction from below upward, by curving it somewhat sharply about an inch from its extremity, and entering it beneath the turbinated bone, as just mentioned; but this exploration is now very seldom made.)

When the canaliculus is to be slit up, we use instead of the probe a delicate grooved director, Figs. 12 and 13, its groove

Fig. 12.



Fig. 13.



upward in the lower, downward in the upper, canal; along this is guided a fine bistoury, either sharp or probe-pointed, which is then made to cut its way out. Some surgeons use merely a fine beaked knife (Fig. 14).

Fig. 14.



It is sometimes desirable to wash out the cavity of the lachrymal sac, as for example in cases of chronic inflammation. Fig. 3, Pl. VIII, shows how this is done with Anel's syringe (Pl. V, Figs. 10, 11, and 12), the tube passed through the lower punctum, as in probing, the operator's other hand steadying the parts to prevent undue pressure.

A better plan is proposed by Mr. Soelberg Wells, viz.: to have the nozzle, about three inches in length, with a crossbar at the top, for separate introduction. To this is fitted accurately a slender India-rubber tube, one and a quarter inch in length, with a plain joint at its extremity, to which the syringe is attached after the canula has been introduced. The patient

Fig. 1.

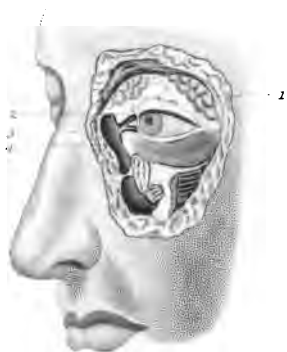


Fig. 2.



Fig. 3.



Fig. 4.

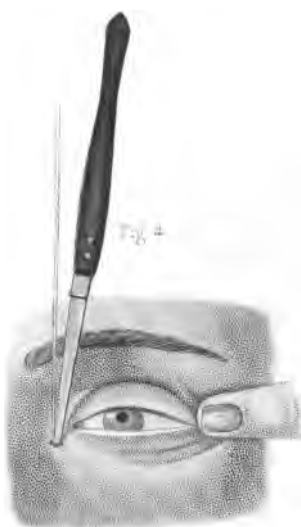
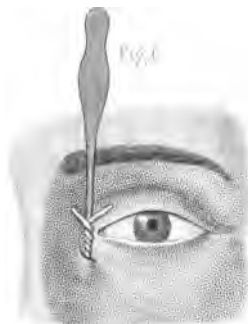


Fig. 5.



Fig. 6.





can then lean his head forward over a basin during the injection.

The operation of puncturing the lachrymal sac, in cases of obstruction, as shown in Fig. 4, Pl. VIII, is now, in some measure, superseded by that of slitting up the canaliculi and passing Bowman's probes. Of these there are from six to twelve, cylindrical, arranged in pairs, as in the cut, Fig. 15, and

Fig. 15.



numbered according to size. The direction of the knife or probe, in either procedure, is that indicated in the plate; some eminent authorities recommend the former instrument, rounded at its extremity, and made to divide the stricture at several points in the circumference. A strong sharp-pointed grooved director, Fig. 16, or a bistoury, Figs. 17 or 18, is sometimes used to make a way for the style.

Fig. 16.

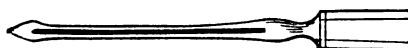


Fig. 17.

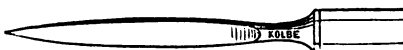
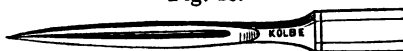


Fig. 18.



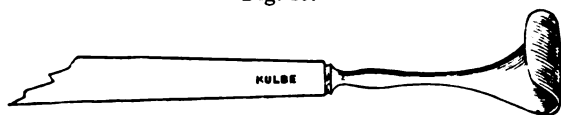
The introduction of the gilt, silver or leaden style (Pl. V, Figs. 13, 14), alongside of the puncturing knife, is represented in Fig. 5, Pl. VIII. Formerly, it was the custom to use bougies of twisted catgut, as seen in Fig. 6; but these are now never employed when any others can be obtained.

(3) OPERATIONS UPON THE CONJUNCTIVA.

In all operations on the eyeball, we must keep the lids out of the way; for this purpose there are several forms of instruments. An assistant may raise the upper lid by means of the elevator, Fig. 19; another may be applied to the lower lid in the

same way, if necessary. Another form of the same instrument is shown in Fig. 20.

Fig. 19.



Or a spring speculum may be used, which keeps itself in place (Fig. 21). (See also Pl. V, Fig. 9.)

Fig. 20.



Another form of self-holding speculum is shown in Fig. 8, Pl. V; it has a branch and a screw to keep it at the desired degree of expansion.

Another form still, having a spring to keep it open, but a screw to regulate the degree of spreading of the branch, is shown in Fig. 22.

Fig. 21.

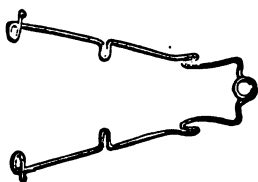


Fig. 22.



In order to steady the ball, as during the operation for strabismus, or for cataract, we may use either a fine single or double

Fig. 23.

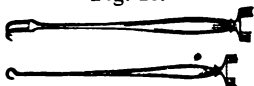


Fig. 24.

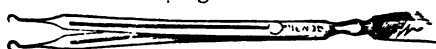
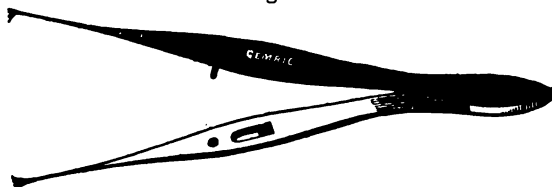


Fig. 25.



hook, Figs. 23, 24, or a pair of delicate toothed forceps, Fig. 25. (See also Pl. V, Figs. 4 and 7.) In either case it is requisite to





Fig. 5



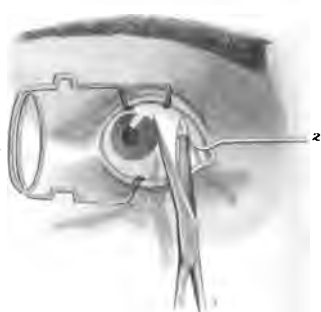
Fig. 7



Fig. 8



Fig. 9



get a firm hold with the instrument; and in order to do this it is best to apply it over one of the tendons inserted into the ball. Thus, in convergent strabismus, we catch the tendon of the external rectus; in operating for cataract, from above, that of the inferior rectus.

In order to dilate the pupil, whether for a cataract operation, or for any other purpose, we use a solution of atropia or one of its salts, gr. j-v to fʒj of distilled water, dropped into the eye half an hour beforehand.

To contract the pupil, the only means we now know of is the Calabar bean. A small quantity of the alcoholic extract of this bean, rubbed up with glycerin or syrup, is dropped in the eye; or a piece of soft paper saturated with it is placed on the conjunctiva.

(a) **Pterygium**, a vascular fleshy growth extending from some portion of the outer margin of the ocular conjunctiva towards the cornea, sometimes requires removal. The patient being etherized, the lids are held apart either by the wire speculum or by the fingers of an assistant, while the surgeon dissects away the mass with a delicate knife and forceps, as in Fig. 1, Pl. IX; working from the centre outward. No hemorrhage not easily controllable by cold water will take place.

(b) When, as sometimes happens in cases of ophthalmia, it becomes necessary to score or lance the inflamed conjunctiva lining the lids, the operation is best done with an instrument such as is shown in Fig. 26; it resembles somewhat the ordinary

Fig. 26.



gum-lancet, having a cutting edge at its convexity. The lid being everted, the knife is drawn several times across it, cutting as deeply as the case may seem to require.

(4) OPERATIONS UPON THE MUSCLES.

Strabismus or squint very often demands an operation for the division of the muscle which causes it by its undue contraction. Usually it is the internal rectus which is at fault; sometimes the superior rectus must also be cut.

Surgical Anatomy.—The anatomy of the muscles must be well understood by any one performing the operation; it is shown in Fig. 2, Pl. IX, the outer wall of the orbit having been removed.—1, eyeball; 2, elevator of upper eyelid; 3, superior rectus muscle; 4, external rectus; 5, inferior rectus; 6, outer part of inferior oblique, inserted into the ball close to the anterior part of the external rectus; 7, tendinous ring affording origin to all the recti muscles, close to the optic foramen.

In Fig. 3, the sheaths of these muscles are shown, terminating anteriorly in a fibrous expansion called the capsule of Tenon. (The references are the same as in Fig. 2.)

Fig. 4 exhibits the four recti muscles of the right eye, with their expansion at their insertions into the sclerotic. The tendon of the superior oblique is seen passing through the loop of ligament which converts the supraorbital notch into a foramen, and which acts as a pulley over which the muscle plays.

Before proceeding to operate, the surgeon should determine, by tests described in works on the eye (Wharton Jones, Stellwag, or Soelberg Wells), which eye is most at fault; occasionally both have to be treated.

There are two untoward consequences to be guarded against in doing this operation: first, the formation of a fleshy prominence or caruncle on the ball, at the point of division of the tendon; and secondly, the retraction and sinking in of the inner angle of the eyelids. When either or both of these conditions exist, there is produced a prominence, more apparent than real, but very unsightly, of the inner side of the eyeball. They are avoided by making the section of the tendon close to its point of insertion, and by disturbing the conjunctiva and subjacent tissue as little as possible.

The instruments required are: a spring speculum or a pair of elevators; two pair of forceps; a delicate blunt hook, Fig. 27, and a pair of fine blunt-pointed scissors, curved on the flat. (Pl. V, Figs. 9, 24, 7, 23, 16.)



Anæsthesia having been induced, the lids are separated, and an assistant draws the ball outward with the double hook, or, which is better, with a pair of fine-toothed forceps. With another forceps, the surgeon pinches up a fold of the conjunctiva a little above the lower edge of the tendon of the internal rectus, and nicks it with the scissors horizontally, perpendicularly, or obliquely. (Some surgeons make an incision along the lower edge of the tendon, passing one blade of the scissors beneath the pinched-up fold.) Next, the tendon is to be

drawn up and divided. This was formerly done, as in Figs. 5 and 6, with forceps.

A better plan, however, and the one now universally employed, is to pass the blunt hook, Fig. 27, through the opening in the conjunctiva, under the tendon (2), thus drawing the latter out (Fig. 8, Pl. IX), and enabling the operator to pass one blade of the scissors alongside of the hook, and to make the division, as in Fig. 9.* The edge of the conjunctival wound should now be lifted a little, and a finer blunt hook swept across the gap in the tendon, to ascertain that all its fibres have been divided. Some surgeons pass the outer blade of the scissors between the conjunctiva and the tendon; others make the section with a tenotome. (Pl. V, Fig. 22.)

Immediately after the operation, the effect produced is to be tested, and if excessive, a fine suture should be passed so as to bring together the edges of the conjunctival wound. Some surgeons always insert a suture or two, to prevent deformity, but this is not essential. In passing these sutures, which should be of very fine silk, delicate curved needles are used; the procedure is greatly facilitated by employing a needle-forceps, different forms of which are shown in Figs. 28 and 29. These

Fig. 28.

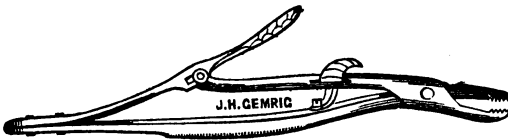
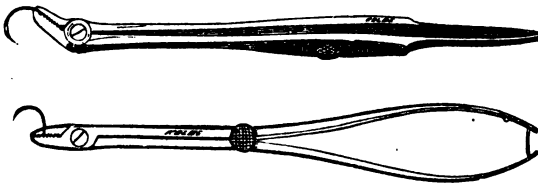


Fig. 29.



needle-forceps are very valuable adjuncts to any case of eye-instruments; the forms shown in Figs. 28 and 29 are perhaps the most convenient made.

* In Figs. 8 and 9, the artist has represented the division of the tendon as made much farther back than it should be.

(5) OPERATIONS UPON THE EYEBALL.

(a) **Operations for cataract.**—In order to understand the operations for cataract,—opacity of the lens (lenticular cataract), or of its capsule (capsular cataract),—it is essential to keep in mind the anatomy of the organ, with which the surgeon should thoroughly acquaint himself. Before venturing to operate on the living subject, not satisfied with this knowledge, he should practise the various procedures on the eyes of calves and sheep, easily obtainable from the butcher, and upon the human cadaver at every opportunity.

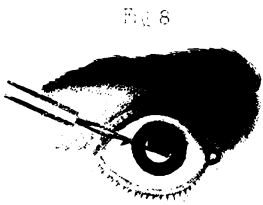
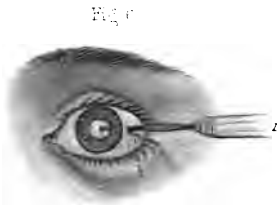
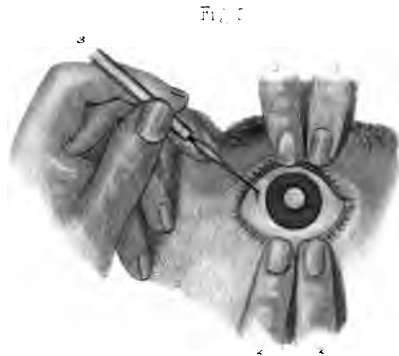
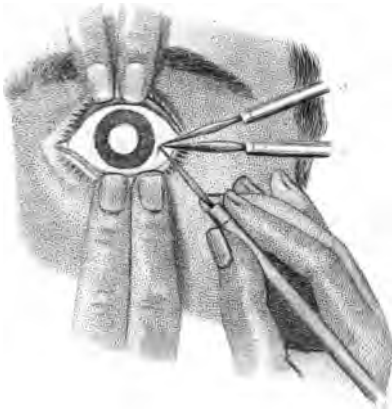
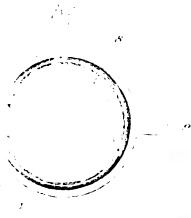
Of the three chief operations for cataract, depression or reclin-
ation, solution, and extraction, the first is now in great meas-
ure abandoned by eye-surgeons, on account of the frequent
occurrence of inflammation and total blindness after it.

Surgical Anatomy.—The eyeball is seen in vertical antero-posterior section in Fig. 1, Pl. X. At the anterior part is the cornea, 1, set like a watch crystal in 2, the sclerotica. Within the latter is the choroid, or pigment-bearing mem-
brane, 3, and within this the retina, 4, or expansion of the optic nerve. At 5 is the iris, the perforated muscular curtain or diaphragm which regulates the amount of light entering the eye; and just behind it the lens, 7. Between the lens and the retina is the posterior chamber, containing the vitreous humor, 8; and between the lens and the cornea is the anterior chamber, containing the aqueous humor, 6. The optic nerve, 9, is seen entering the sclerotic poste-
riorly, and immediately expanding into the retina. The ciliary muscle skirts the outer margin of the iris, and forms one of its attachments to the inner sur-
face of the sclerotic coat, close to the sclero-corneal junction.

Depression of cataract.—The operation of depression con-
sisted at first simply in crowding down the opaque
lens from opposite the pupil or perforation of the iris.
It was improved upon by the proposal to turn it over
backward and downward, as seen in Fig 2, Pl. X.
In Fig. 4 the positions of the needle are shown. The
lids being held apart by an assistant, the needle, a
slightly curved, sharp, double-edged instrument (Fig.
30), is introduced through the sclerotic about two lines
($\frac{1}{8}$ inch) from the outer margin of the cornea, a little
below the middle line, and carried steadily behind the
iris, across the front of the lens, its convexity always
backward. In doing this, it is held like a pen, the surgeon rest-
ing his ring and little fingers against the patient's cheek-bone.
The blade being thus brought so as to bear against the anterior

Fig. 30.







surface of the lens, the handle of the instrument is swept upward, while the blade is pressed backward in such a manner as to rotate the lens downward and backward to 2, Fig. 2, Pl. X.

Fig. 5 shows the manner of beginning this operation in the right eye, the surgeon using his left hand, and entering the needle *above* the transverse diameter of the ball.

Fig. 7 shows the next step, the needle in front of the upper part of the lens. Fig 8 shows the next, the handle of the needle elevated, and the blade pressing the lens downward and backward out of sight.

Absorption or solution of cataract.—Anæsthesia is not absolutely needful for the operation of division, but may be used in cases of children or nervous and sensitive adults.

The operation for absorption is shown in its first stage in Fig. 3, Pl. X. It is applicable to soft cataracts, especially in patients under the age of twenty-five. The pupil having been dilated by means of atropine, and the eyelids opened with a speculum, the needle is entered a little below the median plane, near the corneal margin (it is too far back in the figure), to be carried up in front of the iris, to the anterior surface of the lens. Its handle is now brought up horizontally, as in Fig. 6, and rotated so as to bring one of its edges against the capsule, which is lacerated by a to-and-fro movement to the extent desired. The older the patient, the more limited the incisions should be; the operation may be repeated, if necessary, after all symptoms of irritation have subsided. When the laceration of the capsule is too free, the lens may absorb the aqueous humor largely, swell up, and, by pressure on the iris and ciliary body, produce great pain and disturbance; or fragments of it may fall forward into the anterior chamber, and set up inflammation there.

Another mode of doing this operation is to enter the needle through the cornea, a line or two from its junction with the sclerotic, and below the median plane. The moment the entrance is fairly effected, the point should be so guided across as not to catch in the iris. Arriving in front of the lens, the edge should be turned against the capsule, and made to lacerate it in the same way as before mentioned. Hays's needle, Fig. 31, which is rather a very fine bistoury, answers extremely well for this procedure. Another excellent needle for this operation is that known as Bowman's stop-needle, Fig. 32, which

has a perfectly cylindrical shank, and a shoulder at its middle point.

Fig. 31.

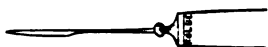
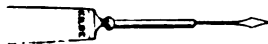


Fig. 32.



Extraction of cataract.—Various methods and modifications of methods have been proposed for the performance of this operation, which consists essentially in the opening of the anterior chamber, and the escape of the opaque lens, either spontaneously, by gentle pressure, or by the instrumental assistance of the surgeon.

Dilatation of the pupil by atropine is always necessary. Anæsthetics will not be required unless the patient is very nervous and timid; and when they are given, every precaution should be taken to avoid the occurrence of vomiting. The patient may lie on a firm bed or table, his head steadied, and the operator standing either beside him or behind his head.

The steps of the operation are:

1. The section of the cornea; made upward, downward, or laterally.
2. The laceration of the capsule (omitted by some operators when lens and capsule are taken away together).
3. The iridectomy (not always, but generally done, except when suction is employed).
4. The removal of the lens, by pressure, by the scoop, or by suction.

Fig. 33.

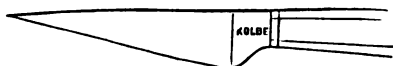
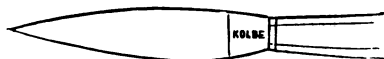


Fig. 34.



The section of the cornea may be made either with Beer's knife (Fig. 33), or with Sichel's (Fig. 34), or by Von Graefe's method (see p. 43). Fig. 1, Pl. XI, shows the method of making the lower flap. An assistant holds up the upper eyelid; the surgeon then, with his left hand, either depresses the lower eyelid, or fixes the ball by grasping the tendon of the inferior rectus with a pair of toothed forceps, while with his right he enters the knife close to the outer margin of the cornea, and carries it nearly straight across, with a steady push, until the counter-open-

Plate XL.

Fig. 1.

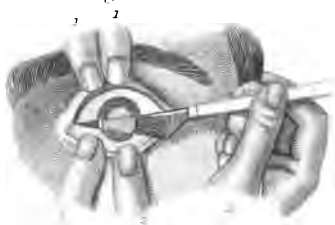


Fig. 2.

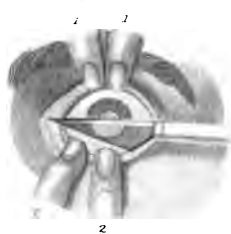


Fig. 5.

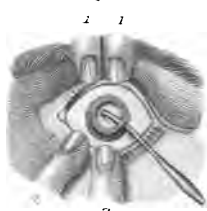


Fig. 3.



Fig. 4.



Fig. 6.

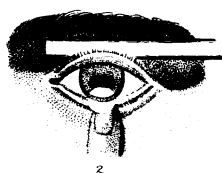


Fig. 10.

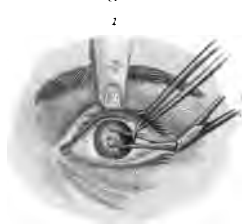


Fig. 8.

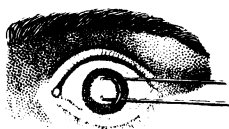


Fig. 12.



Fig. 15.

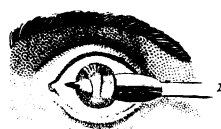


Fig. 9.



Fig. 13.



Fig. 11.

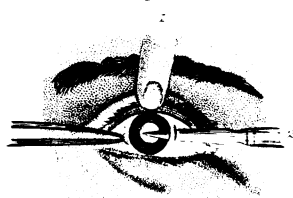


Fig. 14.





ing is made at the inner side. Continuing the same motion, the knife cuts its way out (Fig. 2) and the flap is made.

Upon the removal of the knife, it sometimes happens that the lens is expelled by the pressure from within, and a portion of the vitreous humor may be forced away along with it; when this is the case, the lids should be at once gently closed, and the patient kept as quiet as possible until the corneal wound heals.

But when the lens remains in place, a cystotome (Fig. 35) is gently introduced through the wound, and the capsule is freely lacerated in various directions. (Fig. 5, Pl. XI.) Great care must be taken in so doing, to make no pressure backward against the lens.

Now, withdrawing the cystotome, the surgeon steadies the lower lid and the eye with one or two fingers of his left hand, while with the handle of his knife he exerts a very gentle pressure through the upper lid upon the ball above; when the lens will generally leave its place, slip into the lower part of the anterior chamber, and thence escape by the corneal wound. (Fig. 6, Pl. XI.) The operation is thus completed; the eye is gently closed, and the patient is placed in bed.

Fig. 35.

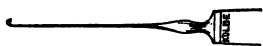
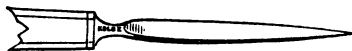


Fig. 36.



In Fig. 3, Pl. XI, an oblique section of the cornea is shown, and in Fig. 4 the upper section, which is at present most in vogue.

Von Graefe's method.—An important modification of these sections, known as the linear method of Von Graefe, has of late years been extensively adopted.

The incision is made with a long narrow knife (Fig. 36), which is entered in the sclerotic, close to the margin of the cornea, with its edge upward; it is carried at first downward and across the anterior chamber, but then, by depressing the handle, its point is brought up so as to emerge through the sclerotic just opposite the place of entrance. The edge is now turned forward, and the knife carried across for nearly its whole length, when it is drawn back again, cutting its way out a line or so above the corneal margin. Thus a *conjunctival flap* is made; the advantage of which is the greater certainty and readiness of union.

Fig. 47.



Fig. 48.



Fig. 49.



(Fig. 50), if operating from the outer side, and one bent on the shaft (Fig. 51), if from the upper or inner side; the eye being

Fig. 50.



Fig. 51.



steadied by means of forceps applied exactly opposite to the point of entrance of the knife. Fig. 11, Pl. XI, shows the mode of making the incision, also on the outer side of the cornea, with the slender knife of Von Graefe. Entering the sclerotic close to the margin of the cornea, the surgeon pushes the knife on, keeping clear of the iris and lens, until the incision is of the desired size; he then slowly withdraws the blade. Next, giving the fixation-forceps to an assistant, he insinuates the iris-forceps, closed, through the wound, catches a fold of the iris, draws it out, and with the scissors snips it off close to its ciliary attachment. (Fig. 12.) This snipping may be done at once, or in two portions. The quantity cut away must vary according to the object; for glaucoma, or intraocular tension, about one-fifth of the iris may be removed, while less will suffice if the object be merely the admission of light.

Again, in the former case the operation may be done from above; in the latter, the inner side of the cornea is better.

The operation completed, the lids are gently closed, a light and well-arranged pledget of fine raw cotton laid over the eye, and a bandage put on to keep it in place. The best form of bandage is a strip of fine muslin or linen, about two and a half inches wide, cut away at either end so as to leave two narrow

ribbons, one to go above and the other below each ear, and to be tied behind.

The subsequent treatment must vary greatly with circumstances.

Some of the older operations for artificial pupil are seen in the remaining figures of Pl. XI.

Fig. 12 shows Mulder's method. The corneal incision having been made, and the iris crucially divided, the angles thus formed were snipped away with fine scissors passed through the opening in the cornea.

Beer's operation is represented in Fig. 13. A very small incision having been made in the cornea, a fine blunt hook was introduced through it, and engaged in the tissue of the iris so as to pull down a flap of it, which was left to adhere to the cornea. A gap was thus left to answer instead of the normal pupillary orifice.

Scarpa's plan, shown in Fig. 14, was to introduce a needle through the sclerotic, as for depression of cataract; the point of the instrument being pushed through the iris, was then depressed so as to tear a portion of it away from its ciliary attachment.

Velpeau's method (Fig. 10) was to push a lance-shaped knife through the cornea and iris, transversely, bringing it out again at the opposite point, and then cutting a flap downward. The flap of iris retracted, while that of the cornea soon became reunited.

The advantages of the present method of iridectomy over either of these must be obvious.

(c) **Iridodesis.**—This operation,—ligation of the iris,—is performed by making a small incision (a broad needle answers very well) close to the margin of the cornea. Through this a fine blunt hook is inserted, the iris caught and drawn out, a small loop of very fine black silk (easily seen) laid around the

Fig. 52.



prolapsed portion, which is then strangulated by drawing on the ends of the silk with two pair of cilia-forceps. (Fig. 52; see also Pl. V, Fig. 6.)

One of the ends of the silk is cut off very short; in a day or

two the loop is pulled away. The corneal wound generally heals speedily, and no inflammation is set up.

(d) **Extirpation of the eyeball** is called for when, sight being lost or greatly impaired in one eye, the other is attacked with sympathetic inflammation; or in cases of malignant disease.

The patient being placed under the influence of ether, an incision is made near the cornea, parallel to its inner margin, exposing the tendon of the internal rectus muscle, which is divided. A pair of scissors curved on the flat is passed along the inner side of the globe, and the optic nerve divided; the eyeball can now be turned outward, and the muscles inserted into it divided successively, as close as possible to the sclerotic, the conjunctival incision being extended as this is done.

Should any bleeding occur, it is readily checked by pressure with a plug of lint, or by a stream of cold water from a small syringe.

The subsequent treatment is like that of any other wound.

Removal of the entire contents of the orbit, for tumors, has been done very often, but seldom with permanent good results. It is not a difficult operation, thoroughness being the great object to be aimed at.

Removal of the anterior part of the eyeball has been so generally abandoned, even by those who were its most earnest advocates, that it need not be here described. Inflammation almost always occurs in the portion left, and gives rise to about as much trouble as if no part had been taken away.

§ III. PLASTIC OPERATIONS ON THE FACE.

The deformities resulting from malformations, diseases, and injuries of the face, such as syphilis, cancer, burns, the bursting of fire-arms, etc., vary so much in character, degree and extent, that the operations for their relief can be described only in general terms, and the practitioner must exert his ingenuity to meet the requirements of each case. Operations of this kind usually consist in three steps: 1, the freshening of the surface at the seat of disfigurement; 2, the freeing of skin, with or without subjacent tissues, so that it may be transplanted without losing its nutrition; and 3, the fastening of it in such a position as to fill up the deficiencies, and restore as nearly as possible the natural appearance of the parts. Not unfrequently the same



Fig. 2



Fig. 4



case requires several operations,—progressive steps towards the final result.

In devising any procedure of this sort, regard must be had to the natural lines and creases of the face; in performing it, a definite plan should be followed, hemorrhage should be avoided or carefully checked, and the parts should be brought into exact apposition.

Fig. 1, Pl. XII, is a representation of a case in which from injury, perhaps in a syphilitic constitution, there was extensive loss of substance in the forehead, together with caries of the frontal bone. Fig. 2 is a diagram of the flaps derived from the surrounding skin, brought into position so as to fill up the gap. On either side an incision was carried from the margin of the opening, so as to include the skin of the forehead in a flap whose free edge was upward; the upper margin and the lateral flaps were then freed from the tissues beneath, and brought together as seen in the diagram. Fig. 3 is intended to give an idea of the degree of improvement in the patient's appearance when healed.

These figures are taken from sketches made by Dr. Watson of New York, in whose wards at Bellevue Hospital the case was treated, and by whom it was reported.*

Where, as in this patient, there is a large ulcer to be covered up, and therefore to be freshened in order that adhesion may take place, it would be an awkward thing to use the knife for this purpose; and the plan adopted by Dr. Watson,—washing the surface with strong aqua ammoniæ, may be substituted with advantage.

Rhinoplasty.—In Fig. 4, Pl. XII, is shown the method now most in vogue for “rhinoplasty,” or *nose-making*. The patient being in good physical condition, the surgeon considers carefully the size and shape of the organ to be supplied, judging from the patient's other features. He then takes a sheet of gutta-percha, and moulds it into the desired form, after which he spreads it out upon the forehead, and traces its outline, which will be much like that in the figure. One-third at least of shrinkage should be allowed for. If the mark is made with nitrate of silver, it will not be washed out by the blood.

One or two scalpels, larger and smaller, *in perfect order*, two or

* American Journal of the Medical Sciences, 1844, p. 537.

three pair of good rat-toothed forceps, an abundance of harelip pins, fine suture needles and silver wire, fine silk or hempen ligatures, and a tenaculum, are needed. Two good scalpels, curved on the flat in opposite ways, are often of great use in plastic operations.

The patient being fully etherized, the surgeon makes a decided incision along the line traced, and dissects the flap up as cleanly as possible. He carries the incision a little lower on the side *towards* which the twisting is to be made. Next, he freshens up all the parts with which the flap is to be connected. All vessels which spring should be carefully twisted or tied; and the edges left to glaze a little while the wound in the forehead is brought together as nearly as may be with harelip pins, sutures and adhesive plaster. The next step is to bring the flap round into its place, as in Fig. 4, carefully avoiding tension on the adherent part, and to fasten it there by means of sutures; a little plug of oiled lint is placed in each nostril to keep it open, and a triangle of strips of adhesive plaster arranged to hold the newly arranged nose steady.

Nothing answers so well as dry lint for the dressing of these cases, unless it be lint just moistened with a very dilute solution of tinct. iodinii (f3j to Oj of water), which has an antiseptic agency, and tends also to prevent suppuration. For five or six days the wound should be left undisturbed, unless hemorrhage or sloughing should unfortunately ensue. After this the surgeon must be guided by circumstances as to the frequency and character of the dressings.

The old Taliacotian method, the flap being taken from the skin at the inner side of the arm, which is bound to the head by a complex arrangement, as seen in Fig. 5, until union has taken place, is very seldom done at present.

The flap was formed in the following manner: Two parallel incisions were made through the skin of the arm, in a longitudinal direction, so as to include a portion of skin judged to be sufficient, allowing for shrinkage. Next, freeing this from the subjacent tissues, the surgeon inserted beneath it a piece of anointed linen, and allowed suppuration to take place for ten days or two weeks; some thickening and narrowing would occur at the same time. Everything being now made ready, the edges of the deficiency were pared, the upper end of the flap separated, the arm brought close to the head, the flap sutured

VASSELIN . . .

Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6



in its new position, and the bandage tightened. In about two weeks more, the lower end of the flap was also separated, shaped, and sutured in position.

Plate XIII, the figures in which are copied from "Pancoast's Operative Surgery," represents the deformity, the operations done for it, and the results, in a case treated by that distinguished surgeon at the Philadelphia Hospital, and reported by him in the *American Journal of the Medical Sciences* for Oct. 1842. The patient was an Englishman, æt. 53, who had sustained an injury several years before, by which "all the soft parts of the nose, and the whole of the upper lip from the commissures of the mouth up to the fossa canina of each side, as well as the septum narium and the turbinated bones, were removed. The cavities of the antrum Highmorianum were opened on each side by destruction of bone, so as to form a mere superficial cavity, in which the ball of the thumb could be placed. The opening of the sphenoidal sinuses could be distinctly seen through the cavern. * * * The teeth with their corresponding alveolar processes were removed from both jaws, the upper of which, instead of its usual arched form, presented the appearance of a thin plate. In consequence of the loss of the alveolar processes, the chin presented the excessive prominence seen occasionally in extreme old age. The free margin of the lower lip when the mouth was closed came up to the nasal cavern, and covered the edge of the upper gum, which was about two lines in thickness. * * * The mouth had been narrowed by union of the lower lip for about half an inch from each corner to the flesh of the cheek above, the line of cicatrization being still visible. When the mouth was opened to its widest extent, it formed a rigid circular orifice three-quarters of an inch in diameter, through which the patient took his nourishment with a small spoon, and could with difficulty protrude the point of his tongue."*

This case is so typical of a very difficult class of deformities, that it will go further than a good deal of didactic description in giving the reader an idea of the way in which they are to be treated.

First, the mouth was attended to. An incision was made on each side outward from the narrowed orifice, through the skin

* Pancoast's Operative Surgery, p. 346; Plate 71.

and tissues almost down to the mucous membrane, and a small portion clipped away with scissors from the four edges thus formed; next, the mucous membrane itself was divided, freed from the gum by incisions, turned out, and attached by sutures to the skin. By so doing, the lips were imitated. Incisions were now made (Fig. 2, Pl. XIII) on either side upward and outward, one and a quarter inch, *a, b*, and from the extremities of these one and a quarter inch downward and outward, *c, d*, when by bringing *a* and *b* in contact, the width of the upper lip was restored, and the mouth lowered into place (Fig. 3). Consolidation having taken place, in two months the new nose was formed, in the Indian method, modified as follows: An incision was carried "down to the bone just at the outer side of the nasal chasm. The integuments were then dissected each way from this incision, so as to leave a groove between them for the lodgment of the edges of the new nose. The inner margin was raised up so as to form a vertical wall, for the purpose of bringing the raw surface into contact with the raw side of the flap, and thus giving an increased probability to the adhesion of the graft; to render the union still more certain, the triangular piece of skin enclosed by the two grooves at the end of the *ossa nasi*, was cut away, and the cuticle pared off from the edges of the flap with which the new nose was to be formed. Three waxed silken ligatures, with a needle at each end, were placed at each side, by passing one needle from without inward through the inner wall of the groove, and again in the opposite direction about an eighth of an inch above the first puncture, so as to leave the two needles of each ligature resting on the cheek, with a loop through the inner wall of the groove" in the nasal cavity, as seen in Fig. 4. (Only one of these, the lowest, is represented, in order not to confuse the figure.) Now, the flap having been twisted down into place, "the two needles at the end of each ligature were passed through the margin of the flap from within outward, and again through the integuments on the outer side of the groove, so that when they were drawn tight they necessarily sunk the edge of the flap to the bottom of the groove, and brought four raw surfaces into contact. The dots on the edge of the flap (Fig. 4) represent the points through which the threads of each ligature were passed, after the flap was twisted round. The threads were tied over small rolls of adhesive plaster, so as not



Fig. 1



Fig. 2



Fig. 4



Fig. 5



to strangulate the parts included in the loops;" the middle ligature was placed farthest from the edge, and the corresponding roll of plaster was made a little longer than the others, so as to bear against the new nose, and cause a slight depression such as naturally exists at that part. "A small ligature was then passed through each edge of the integuments of the new column near its root, and tied upon one side, so as to give a rounded form to the new column, by bringing the two lateral surfaces together posteriorly, as well as to prevent its adhering to the margins of the new alæ. The cuticle was removed from the lower end of the column by a bevelled cut; the column was then pushed in upon the gum, and secured upon the new upper lip by two pins, one of which was semicircular." The after-treatment was as usual, until "having allowed five weeks to elapse for the process of shrinking and contraction to become in great measure arrested, the pedicle, which contained the angular arteries, was divided. A director was for this purpose passed between it and the bridge of the nose, where there was of course no adhesion of parts, and the pedicle divided from the left to the right side obliquely upward. A loose triangular lamina, which shortened itself considerably after division, was thus left attached to the new nose. The bleeding from the angular arteries was stopped by pinching with the forceps. The triangular piece was diminished by paring off the sides, and shaving away a portion of its inner surface; it was then smoothly fitted down over the root of the ossa nasi into a cavity, made by the excision of a portion of the subjacent integument for the purpose. A few stitches of the interrupted suture, and a compress and bandage completed the dressing. On the third day the sutures were removed. Some suppuration had taken place along the left line of junction, and there was considerable tumefaction of both canthi. By the twelfth day, the union was smooth and perfect."

Fig. 6 shows the ultimate result of this remarkable case, being copied from a sketch taken sixteen months after the patient left the hospital. The deformity was so far remedied that the man's face would not attract attention in public.

Plate XIV shows some other rhinoplastic operations. One-half only of the nose having been lost, such a flap as that represented in Fig. 1 should be made. Observe that, the deficiency being on the *left* side, the widening for the new ala, in the flap,

comes to the *right*; so that when the flap is twisted downward, its shape is accurate. The same plan as in Pl. XIII, Fig. 4, of letting a wedge-shaped edge of the flap fit into a groove in the parts at the edge of the deficiency, is followed here; and the sutures are made in the same way.

These figures, reduced from plates in Pancoast's "Operative Surgery," are representations of an actual case, the loss of tissue having been due to lupus.

The remaining figures in this Plate, derived from the same source, show a case also operated on by Dr. Pancoast. The hard palate, nasal septum, and all the soft tissues except the tip of the nose, the alæ, and columna, had been destroyed, leaving the deformity seen in Fig. 3. An incision having been made across the organ, the tip could be drawn down as in Fig. 4, leaving a triangular cavity, to fill which two flaps of like shape were borrowed from the cheeks. Fig. 5 shows the new organ ten months afterwards. Fig. 6 exhibits the flaps, as taken in Fig. 4, fastened in place by harelip sutures; and the gaps left in the cheeks closed in the same manner.

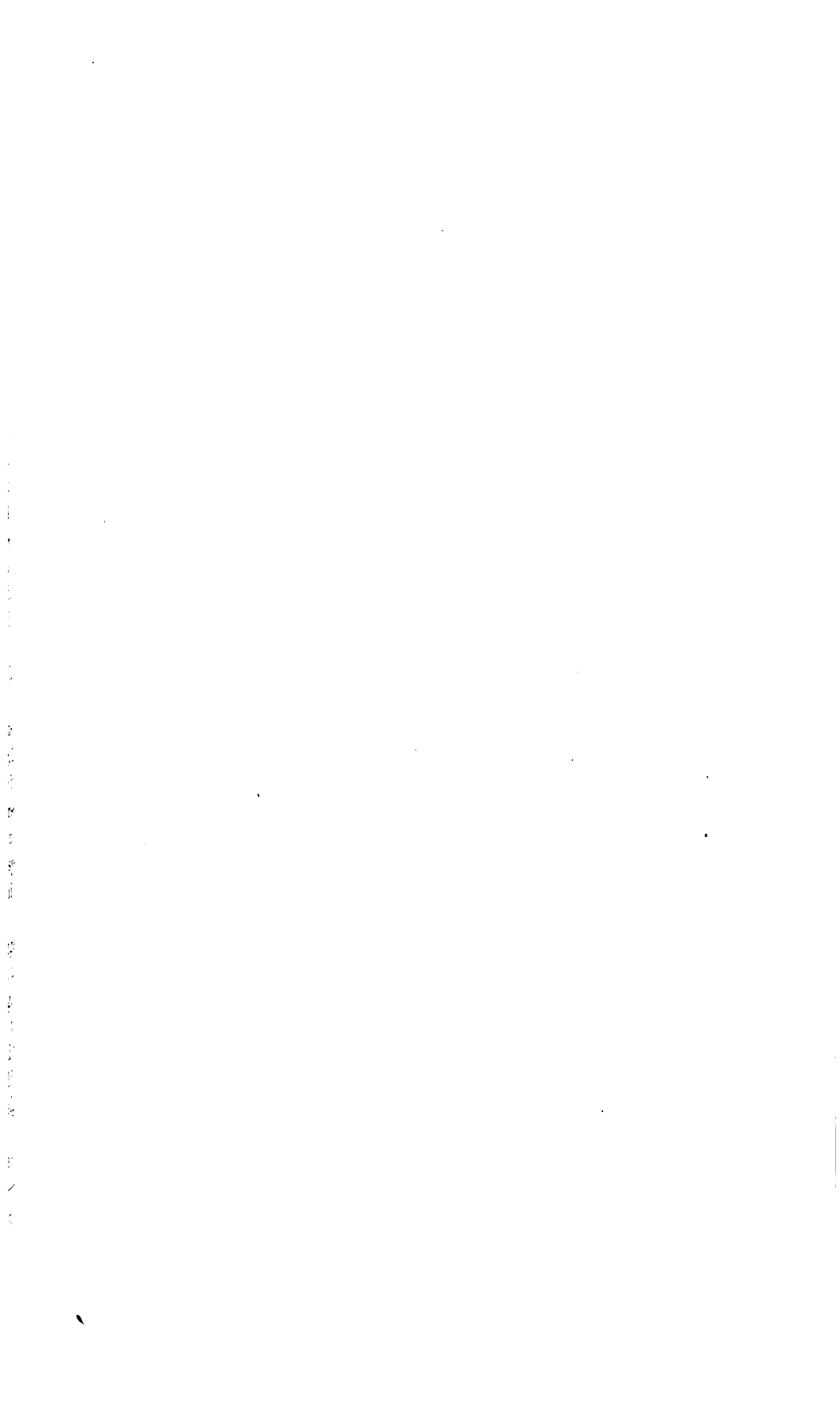
All the flaps, in this case, were made with bevelled edges, in order to ensure their readier coaptation and adhesion.

Destruction of the cheeks by ulceration from the too free use of mercurials, formerly not unfrequent, is now very rare. Fig. 1, Pl. XV, represents a case of this kind, with the operation for its relief, performed by the late Dr. Mütter. As a matter of course, the surgeon should abstain from all such interference until not only the local mischief is arrested, but the condition of the system is so far improved as to afford a prospect of the ready union of the parts when brought together.

In the first place, any teeth which, by projecting or ragged edges, or by their bulk, might interfere with the flaps, should be removed. Next, the tissues may be divided, as in Fig. 1, upward and downward; care being taken to leave intact the duct of Steno, if this has not already been destroyed, and to avoid the facial artery. Four skin flaps are thus formed, which are to be turned downward and upward so as to bring the edge *a* to *b*, and *c* to *d*.*

Before fastening the flaps together, all bleeding should be ar-

* An account of this case may be found in Liston's "Lectures on Surgery;" Mütter's edition, p. 243.





rested, by ligature if necessary; exposure to the air, with the application of cold, will often stay mere oozing.

Another method of dealing with these cases is that of Lallemand, shown in Fig. 2, Pl. XV, also from Mütter's edition of Liston's "Surgery." Here the angle of the mouth had not been destroyed. The cicatricial tissues at 1 having been excised, a flap of integument, 2, was dissected up and turned round so as to fill up the opening, and fastened in its new place by sutures.

Complications.—One of the most important of these, immobility of the lower jaw, arising either from ankylosis or from stiffening of the soft parts, existed in the case represented in Fig. 1; and was overcome by division of the masseter muscle from within outward, with subsequent gradual forcing of the jaws apart by means of Heister's screw, or some of the modifications of it which have been devised. The general plan of all these instruments is the same; two plates of steel introduced between the jaws, and then forced apart by the turning of a screw.

Sometimes the operation for epithelial cancer of the lower lip is to be done when so much of the tissue is involved that a large gap must be left in removing the disease. Such a case is shown in Fig. 3, Pl. XV, with a method devised by Prof. Pancoast for supplying the loss. Having dissected away the tumor, the surgeon extends an incision downward in the median line nearly as far as the hyoid bone, and then makes another one across it, parallel with the edge of the lower jaw. (The exact length and direction of these cuts must be determined by the surgeon's judgment in each case.) Now, by rounding off the angles of the four flaps thus made, and stitching together the tissues in the median line, the raw edge left in the removal of the tumor is pushed up so as to take the place, as nearly as may be, of the lower lip.

Fig. 4 represents Chopart's plan for attaining the same object. After removing the tumor by the three incisions, 1—2, 3—4, 2—4, the surgeon extends the vertical cuts down to 5 and 6. By freeing the flap thus made, he now is enabled to draw it up so as to bring the line 2—4 into position as a new lower lip, securing it thus by sutures applied laterally.

When the epithelial growth occupies the corner of the mouth, an operation such as that of Lallemand, Fig. 5, may become

necessary. The tumor being thoroughly removed, the surgeon carries an incision down the front of the neck, and then makes another from a little below and in front of the angle of the jaw, joining the former at its lower extremity, so as to mark out a flap free on two sides, and attached by a somewhat wide pedicle. Dissecting this flap away from the subjacent tissues, he now turns it with its lower extremity inward, so as to bring 1, 2 and 3 together as a commissure of the mouth, the deficiency in tissue being made up by the transplanted skin.

(The second incision on the neck should be made more convex outward than it is represented in the figure.)

Cold or warm water dressings, with or without astringents or demulcents, may be used.

Harelip.—Cases of harelip are of very common occurrence in children, and require operation, not only to correct the frightful deformity they present, but to facilitate sucking. Sometimes, but rarely, they result from injury, at more advanced periods of life. In the former class of subjects, they are often complicated greatly, especially when the cleft is double, by deficiencies in the maxillary bones.

The surgeon's duty is to close the fissure, by paring its edges and bringing them together; and in so doing he must save all the tissue he can, and imitate the natural shape of the upper lip as closely as possible.

As to the time of operating, the best rule is to do it as early as practicable; it has been done successfully within the first twenty-four hours after birth. The instruments required are: a small scalpel or bistoury, forceps, a thin wooden spatula (a paper-knife answers very well), three or four pins, either steel or silvered, and some fine silk or linen thread. Instead of the pins, ordinary silk or wire sutures may be used.

The child should be wrapped in a folded sheet or blanket, and held on the lap of an assistant, its head well steadied on his arm. The surgeon sits in front, his instruments within easy reach; another assistant holds the end of the wooden spatula behind the lip.

With the bistoury, the surgeon now prepares the raw surfaces which are to be brought together. The old plan was simply to cut away the edges of the cleft in straight lines.—But as this left the edge of the lip with an obtuse angle, concave downward, it was proposed to make the incisions semi-elliptical, as

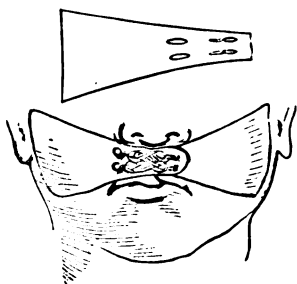
with the pins; and it is no doubt an additional means of safety.

Some authors, among them the late Dr. J. Mason Warren, of Boston, advocate the use of the ordinary interrupted suture instead of that made with the pins, on the ground of its being equally secure, and less apt to give trouble by excoriation.

When, as sometimes happens, there is profuse hemorrhage from the coronary arteries, upon the section being made, one of the pins or sutures may be passed just at the level of the bleeding vessel, which is thus transfixed, and closed.

The operation being completed, a piece of adhesive plaster, or of the finest gold-beater's skin, shaped as in the cut, Fig. 55,

Fig. 55.



should be applied on either side, the tips of each pin, if pins are used, being taken into the button-hole openings, and the wide part spreading out over the cheek. When the interrupted suture is employed, the same purpose is answered by merely cutting out a dumb-bell-shaped piece of adhesive plaster, the narrow portion being applied over the lip, and

the wide ends taking hold on the skin of the cheek. The object of this is of course merely to give support to the sutures, and afford additional security against any separation of the newly-apposed edges.

In Fig. 7, Pl. XVI, is represented a contraction of the mouth, and the lines of incision in Dieffenbach's operation for its relief. On either side the skin and subcutaneous tissues are cut away down to the submucous layer; the mouth is then extended outward in each direction by a straight cut, so as to make it a slit instead of an orifice. The mucous membrane is now turned out so as to imitate the normal lip, above and below on each side, and its edges fastened to those of the skin by means of sutures.

Any irregularities in the position of the contracted orifice must be provided for by modifying the extent or direction of the cuts, and in so doing the surgeon must use his judgment in each case.



Fig. 4

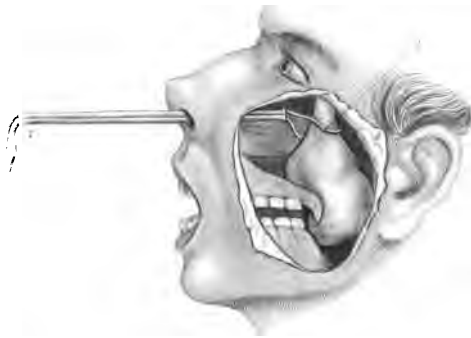


Fig. 5



Figs. 8 and 9, Pl. XVI, represent an operation of this kind in a case of ulceration, one side of the mouth having become closed by adhesion, and the teeth left bare by the loss of substance on the other. First, a triangular portion of the skin and subjacent tissues is dissected away, either with a knife, or in the following manner: the surgeon (standing facing the patient, and on his left side, to operate on the left side of the mouth, and behind the head to operate on the right side of the mouth) passes his left forefinger into the orifice, and thrusts it between the teeth and the adhesion, so as to make the cheek tense, and steady the parts; he next pushes the sharp blade of a pair of scissors through the skin at the proposed point for the angle of the mouth, and forces it onward in the line 3—4, so that when the instrument is closed it shall divide everything but the mucous membrane. By repeating this process in the line 3—5, a triangle is defined, two of its sides being the incisions just described, and the third, 4—5, the edge of the contracted orifice. Next this flap is dissected away down to the mucous membrane (Fig. 8); and then the latter being divided (Fig. 9), its two flaps are turned outward and sutured to the edges of the skin, so as to form the “vermilion border” of the new lip above and below.

§IV. OPERATIONS ON PARTS WITHIN THE NASAL CAVITY.

Surgical Anatomy.—Fig. 1, Pl. XVII, represents a vertical section of the face in the median line, exposing the right nasal cavity, the right half of the mouth, pharynx and larynx.

1, the middle turbinated bone; 2, the inferior; 3, the cartilaginous portion of the nose; 4, edge of the palate-plate of the right upper maxillary bone; 5, the hard palate or roof of the mouth; 7, middle meatus, and 8, inferior meatus, of the nose; 10, section of the soft palate; 12, section of the epiglottis cartilage; 13, pharynx laid open; 14, section of the tongue; 15, origin of the geniohyoglossus muscle, one of the intrinsic muscles of the tongue; 16, section of the lower jaw; 18, section of the soft structures forming the chin.

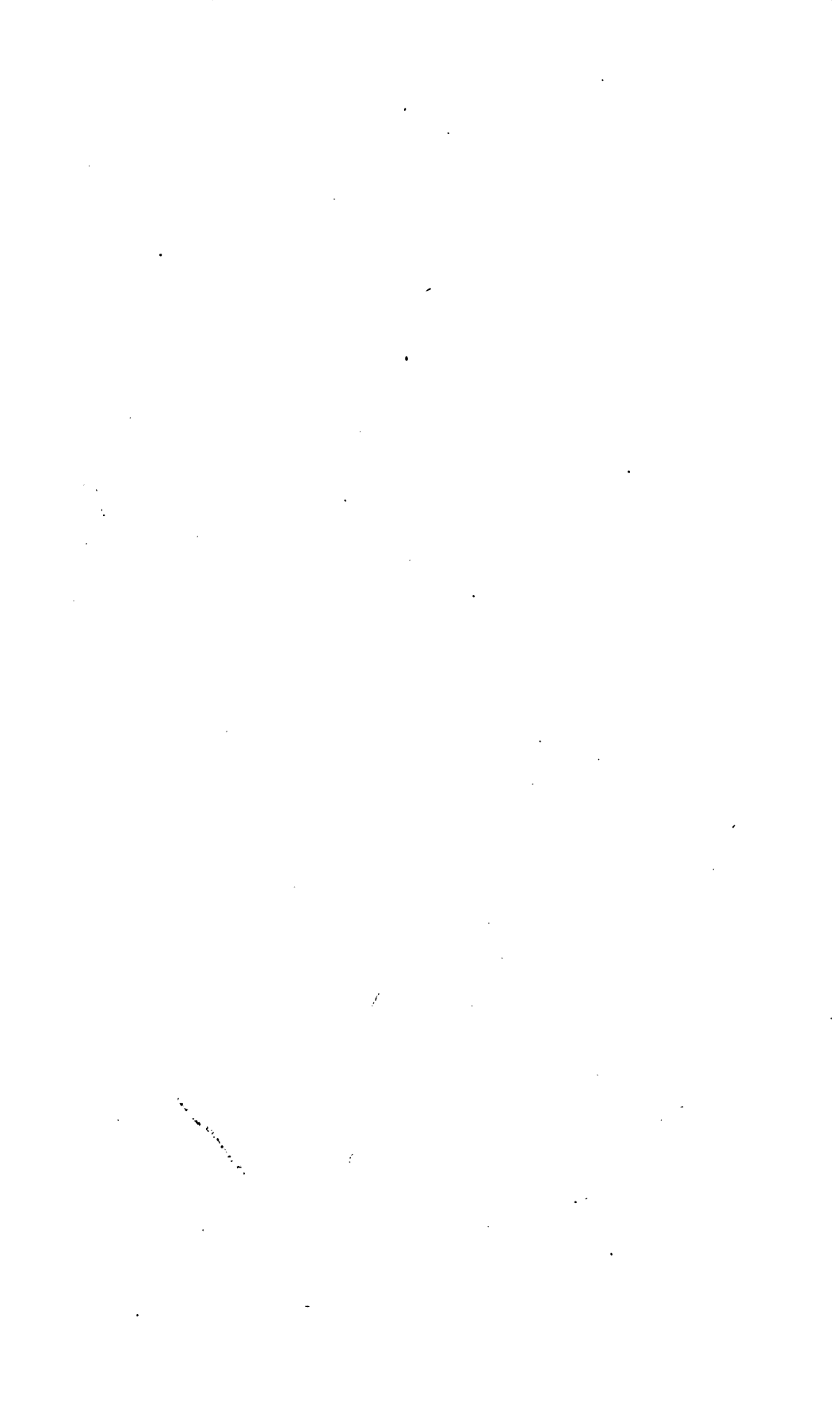
Four operations are represented in Fig. 1, Pl. XVII.

Catheterism of the Eustachian tube, by means of the instrument shown at 6. The catheter used by Toynbee was “not quite so large as an ordinary crowquill;” but its outer extremity was larger, so as to admit the nozzle of a syringe, or the end of the tube called the *explorer*. (For these accessories, as well as for the circumstances requiring the operation, etc., the reader is re-

ferred to works on aural surgery.) In order to pass the catheter, the surgeon places the patient opposite him, and introduces the instrument, its concavity downward, into the nostril of the side to be examined; it is made to glide backward, by the side of the septum, until its point reaches the mucous membrane at the back of the pharynx. Now, being withdrawn slightly, and rotated on its long axis so as to bring its point upward and outward, the latter will become engaged in the orifice of the Eustachian tube, and will no longer rotate freely. Various plans have been devised for retaining the catheter, either for dilatation of the tube when strictured, or for the greater freedom of the surgeon's hands in injecting liquids or air.

Probing the nasal duct.—Another operation shown in the same figure is the introduction of the sound or probe into the nasal duct from below. The handle of the sound, known as Laforest's, is seen at Fig. 1, 9; it is somewhat irregularly S-shaped, and its shaft is to be traced just under the anterior extremity of the inferior turbinated bone, the point being already engaged in the duct. This operation is now almost entirely superseded by that of puncturing from above, before described. [See (2).]

Plugging the posterior nares.—This procedure is not often necessary, but is sometimes indispensable, to arrest hemorrhage. For this purpose the instrument known as Bellocq's canula, shown at 11, Fig. 1, is very useful. It consists of a curved tube, containing a spring, with an eye at its extremity. A double ligature is passed through this eye; the tip of the instrument is then carried along the floor of the nostril, down the posterior surface of the uvula; and the spring being projected, starts forward into the mouth. Now, catching the ligature with a forceps, or hook, as seen in Fig. 2, Pl. XVII (the canula being omitted to avoid confusion), the surgeon draws one end of it out through the mouth, ties a pledget of charpie or lint to it, and then retracts the spring. By pulling upon the end of the ligature, which is still hanging out of the nostril in front, the pledget is brought close to the end of the canula, which, being retracted, acts as a guide to conduct the pledget to its desired position in the posterior part of the nose. The instrument is now readily withdrawn through the nostril, by slipping it forward along the ligature, which is finally freed from the eye at the end of the spring, and fastened by a strip of adhesive





plaster to the cheek, so as to prevent the pledget, if loosened in any way, from falling into the throat.

Upon an emergency, this operation may be done with a piece of curved wire looped at the end, the forefinger being introduced into the mouth to catch and guide it forward from behind the uvula. All the other points of the procedure are done in the way before described. The author has been obliged to use the eyed probe of the pocket case for this purpose; but it is hardly long enough to answer well.

Polypus of the nose.—This very troublesome and disgusting affection may occasionally be removed by strong astringents drawn into the nose, or by the blowing in of powdered alum. But it generally requires an operation.

Sometimes the growth may be twisted or torn away with forceps, astringents being afterwards employed to complete the cure.

Or, by means of a double canula, Pl. III, Fig. 22, a ligature may be cast around the base of the growth, as in Pl. XVII, Fig. 4, and tightened so as to strangulate it.

Fig. 3, Pl. XVII, shows the employment of the "porte-ligature" of Charrière in catching a ligature passed through the nostril, and in guiding it around a polypus lying far back in the nose.

In one case, where this plan had been repeatedly adopted without permanent success, Dr. Mott removed a portion of the bone, as in Fig. 5, Pl. XVII, so as to get at the root of the growth; he had the satisfaction of effecting a cure.

Operations of this kind are far easier in theory than in practice, the difficulties arising from the obscurity of the parts, and the very confined space to be worked in. Sometimes they may be simplified by rhinoscopic examination; but this in itself requires no small skill and experience to be in any degree satisfactory.

§ V. OPERATIONS ON THE PARTS WITHIN THE MOUTH.

Surgical Anatomy.—Fig. 1, Pl. XVIII, shows the relations of the parts within the mouth. The tongue being depressed, the uvula, 1, is seen depending at the posterior edge of the hard palate. On either side is seen the tonsil, enlarged, 2, 3. In front of this is the anterior half-arch, containing beneath the mucous membrane the palato-glossus muscle, and behind it the posterior half-arch (only the upper part of which is visible, 4), containing the palato-pharyngeus

the soft parts, but the bone; the palatal portions of the upper maxillary and palate bones being deficient at the median line.

As a general rule, it is better not to do this operation in children, but to defer it until the patient is able to appreciate its importance, and to exert the needful self-control. Anæsthesia should either be dispensed with altogether, or induced only after the incisions have been made and the bleeding checked; otherwise the amount of blood swallowed may give trouble.

The steps of the operation are: the separation of the soft parts, including the periosteum, from the bone; the freshening of the edges of the cleft; the division of the posterior pillars of the fauces; the introduction of the sutures; and the approximation of the edges.

At least two assistants are required, one to steady the head, and the other, who should be skilful and experienced, to hand the instruments (with which he should be thoroughly familiar), and to aid in the adjustment of the sutures. Another is needed to give the anæsthetic, if such is used.

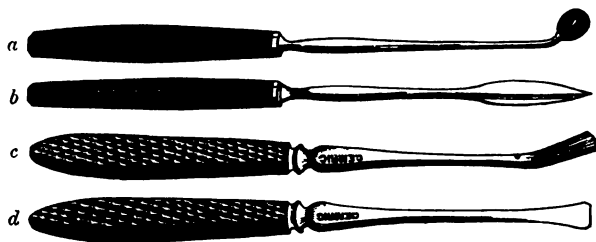
The instruments necessary are: two scalpels, with long handles and short blades curved on the flat, one to the right

Fig. 59.



and the other to the left; or one of like shape but double-edged, Fig. 60, *b*; two strong bone knives, also curved on the

Fig. 60.



flat, and with long handles, Fig. 60, *c*, *d*; one or two pair of long, curved, toothed forceps, Fig. 59; a pair of long scissors, curved

Plate XIX.

Fig. 1.

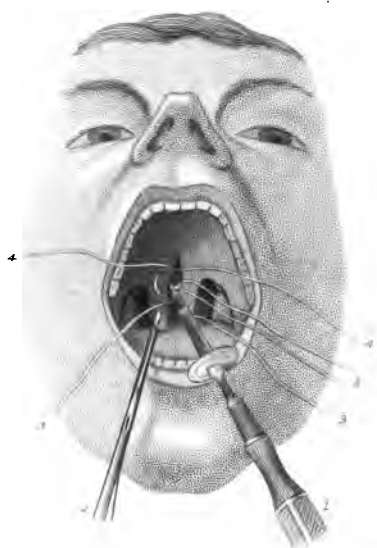


Fig. 2.

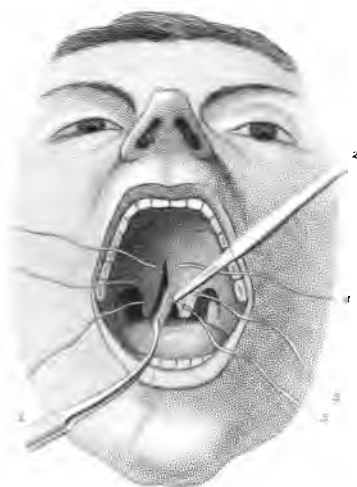


Fig. 3.

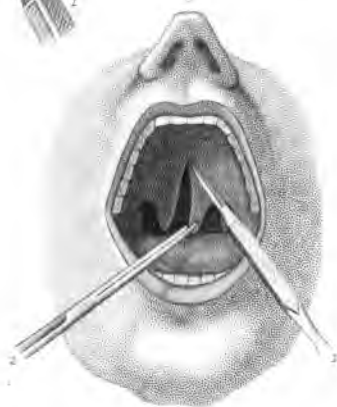


Fig. 4.

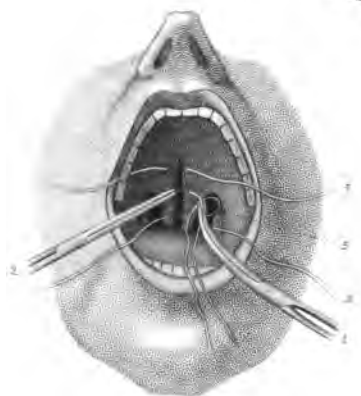
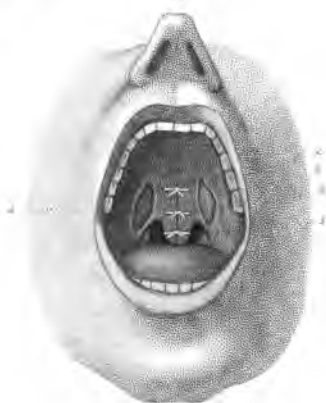
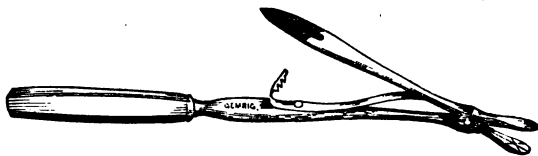


Fig. 5.



on the flat; very short, curved needles, armed with suture threads, and needle-carrying forceps, Fig. 61; one or two knot-tiers, with forked ends, or an instrument such as that shown in Fig. 60, *a*, if wire sutures are employed. Half a dozen small

Fig. 61.



sponges, each tied firmly at the end of a piece of whalebone eight inches in length, will be useful. A small vessel with a strong solution of alum, or some other active styptic, should be at hand.

From time to time, very complicated needle-carriers have been devised for the performance of this operation, and variously shaped knives and scissors proposed. I shall not undertake to enumerate these; the apparatus mentioned above is amply sufficient.

For some weeks before the operation is attempted, the patient should practise himself in keeping the mouth widely opened for a length of time, and accustom the fauces and palate to being touched.

Operation.—The patient being seated in a strong light, his head firmly supported against the breast of an assistant, the surgeon begins by paring the edges of the cleft. Pancoast's method of doing this is the best.* With a pair of forceps in his left hand, he "takes hold of the uvular margin of the right portion of the velum, and puts it on the stretch. The point of the double-edged knife is then to be entered just above the point of the forceps, from before backward, and the knife (edge) carried up a line above the apex of the fissure, so as to detach the rounded border of the fissure in a narrow strip. The knife as well as the forceps is then withdrawn, leaving the strip as yet adherent at its upper and lower ends, so as to leave no floating point to irritate the passages. The patient is now to rinse out the mouth. A similar operation is then done on the opposite margin of the fissure; but this time the knife is run up to

* Operative Surgery, p. 260.

Surgical Anatomy.—Figs. 1 and 2, Pl. XX, show the relations of the parts mainly involved in this procedure. In Fig. 1, the skin and superficial fascia have been removed so as to expose the glands, vessels, nerves and muscles. At 1 is seen the parotid gland, irregular in shape, situated just in front of and below the ear, behind the angle of the jaw; it is limited above by the zygoma. Its duct, 2, runs forward to the anterior edge of the masseter muscle, and there dips inward to open within the mouth opposite the second molar tooth of the upper jaw. The gland is traversed by the external carotid artery, which gives off the facial, 4, just before entering it, and during its passage, the posterior auricular, transverse facial, and internal maxillary; each of these vessels has a corresponding vein. From behind forward the gland is pierced by the portio dura or facial nerve.

The submaxillary gland, 3, is seen lying just under the edge of the lower jaw. It should be noted that the external jugular vein and the branches immediately forming it are separated from the external carotid artery by the sternocleido-mastoid muscle; and that the submaxillary gland lies between the facial artery and its vein. In both instances the veins are superficial.

Fig. 2 shows a deeper dissection, the parotid and submaxillary glands having been removed. The veins corresponding to the external carotid and its branches are seen forming a common trunk, the internal jugular. The gland tissue has been cut away from around these vessels and the facial nerve.

Salivary fistula.—Fig. 3, Pl. XX, represents an operation for the cure of salivary fistula, devised by the late Dr. Horner. In this rare affection, an opening exists through the skin into the duct of Steno, and the saliva constantly flows out over the cheek. Horner's method consists in inserting into the mouth a wooden spatula, which is pressed against the inside of the cheek with the surgeon's left hand, while with the right he first slightly enlarges the external orifice, and then drives a small punch directly through all the tissues into the mouth, against the spatula. A free passage into the mouth being thus provided for the saliva, the next step is to close the external orifice; which is done by the accurate application of sutures and adhesive strips. Until the edges are thoroughly united, it will be well for the patient not to lie with his head on the side operated on, since the saliva would tend by gravity to find its way again through the skin.

Resection of the upper maxillary bone.—This operation is usually rendered necessary by tumors of the antrum or of the bone itself. Sometimes the entire bone has to be removed, but often the line of section may be below the floor of the orbit. The instruments required are: one or two strong bistouries and scalpels; bone nippers and forceps; instruments for arresting

Fig 1.

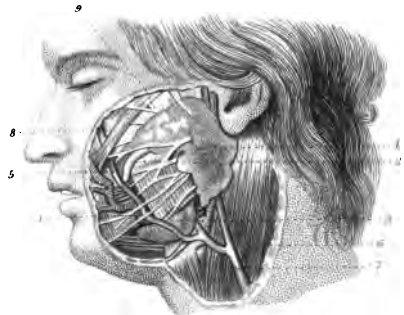


Fig 2.

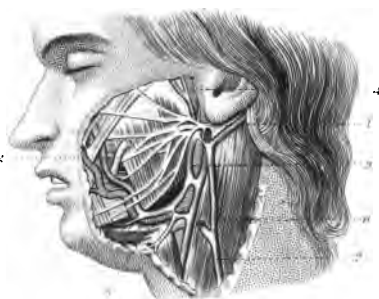


Fig 3.



Fig 4.



Fig 5.

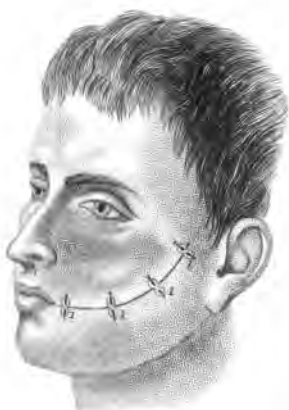


Fig 6.



hemorrhage (among them cauterizing irons); blunt hooks and dilators; one or two elevators; and suture needles.

No inflammable anæsthetic, such as ether, can be used in this operation; hence chloroform is generally chosen.

The steps of this operation are: the division of the skin and subjacent tissues so as to expose the bone; the section of the bone; its removal; the closure of the wound. Bleeding is apt to occur at any stage of this procedure, and must be carefully arrested.

This is one of those surgical procedures in which expedition is highly desirable; since the hemorrhage will certainly be very free, and large quantities of blood are apt to be swallowed. During the early steps, the vessels should be quickly but carefully tied as they spring; the moment the removal of the diseased parts is accomplished, the cautery should be effectively applied where the blood is seen welling up into the chasm.

There are several ways of exposing the upper maxillary bone for removal. Perhaps the simplest possible is shown in Fig. 5, Pl. XX; the knife being entered at the angle of the mouth, and made to divide all the tissues of the cheek in a curved line to a point somewhat in front of the middle of the zygoma, Pl. XXI, Fig. 3, *c*. The flap thus made may be turned up so as to give complete access to the bone, as in Fig. 4, Pl. XX. One advantage of this incision is that the vessels are cut across directly, and can be easily tied.

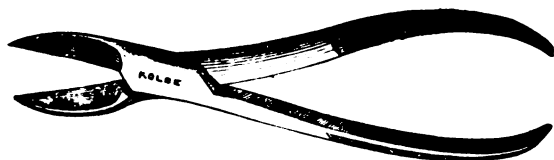
Another method, much more complicated, is that of Gensoul (Fig. 6). A transverse cut, 1—2, on a level with the ala of the nose, or about opposite the middle of the bone, is joined by a vertical one, 3—4, extending from the inner side of the internal canthus to the angle of the mouth. Another vertical cut is made from 1 to 5, near the outer canthus of the eye. By referring to the figure it will be seen that by turning aside the three flaps, one rectangular and two triangular, thus marked out, the bone is entirely exposed. The bleeding met with in this way is somewhat less readily managed.

Another method, and a very excellent one, is to carry an incision from a point at the side of the nose about opposite the inner canthus, down along the edge of the ala to the median line, and then through the thickness of the upper lip (Pl. XXI, Fig. 3, *a*). If the opening thus made is too small, an additional cut may be carried outward just below the lower margin of the

orbit. The bleeding caused by this incision is about the same, and from the same vessels, as in the last method.

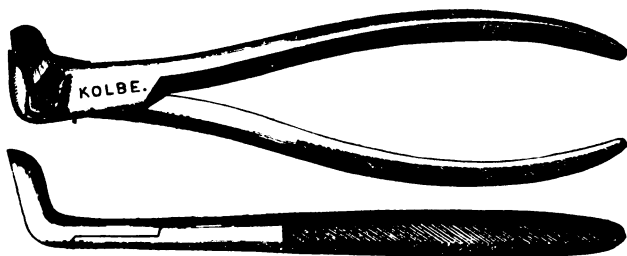
Having exposed the bone, the surgeon's next object is to detach and remove it, either wholly or in part. For this purpose, the bone nippers and forceps will almost always suffice. If the whole bone must be taken away, the palate plate is first divided (an incisor tooth being previously drawn, if necessary), by passing one blade of a strong pair of bone nippers (Fig. 62) above, in

Fig. 62.



the nose, and the other below, in the mouth. The nasal process is next divided in the same way, and then the malar; the soft parts being dissected away so as to give the bone-nippers a clear cut at the bone. A pair of cutting forceps bent at an angle, as in Fig. 63, will often be found more convenient than any other;

Fig. 63.



they can not only be used to more advantage, but the operator's hand is not in the way of his seeing the exact point of application of the blades.

Upon grasping the alveolar portion of the bone with a pair of Ferguson's "lion-jawed" forceps (Fig. 64), and swaying it gently to and fro, the whole mass, with any tumor that may be attached, will generally become loosened, and be easily brought away by a few touches with a bistoury to divide the soft parts. The surgeon now explores the cavity with the finger and eye,

clears it of any remaining disease, sponges it out, applies the actual cautery, and closes the wound; filling the cavity with a mesh of lint, to which a ligature is tied and left hanging out, so as to be readily withdrawn in two or three days.

Fig. 64.



If it is necessary to take away the lower part of the bone merely, leaving the orbital plate, the surgeon either enters the anterior wall of the antrum with a small trephine, or, especially if it be thinned by absorption, he may force one blade of a pair of sharp nippers through it, and then with the same instrument carry the section around the inner, outer, and posterior walls. The remainder of the operation is done as in the last case, and the mode of dressing is the same.

In Figs. 5 and 6, Pl. XX, the wounds made in the operations of Warren and Gensoul are shown closed by the harelip suture. Some authors advise in preference the ordinary interrupted suture, but there is in fact not much choice between the two. There is very little stress on the edges, after the removal of so large an amount of the subjacent bony structure.

In some cases, by making the same division of the soft parts, the antrum may be entered, its anterior wall removed, and the disease extirpated, without sacrificing the palate or dental arch; a plan by which the symmetry of the face might be in some degree preserved, although the strength of the jaw would probably never be restored.

Very great relief is often given by these operations, even if a permanent cure is not effected. In 1864, I removed the right upper maxillary bone of an old lady who had suffered untold agonies for many months, and for nearly two years afterward she lived in great comfort. But the importance of rapidity in operating, and especially in arresting hemorrhage, can scarcely be too much insisted upon. Twice within three months I have seen death ensue from excessive bleeding in cases of this kind.

A great part of the upper maxillary bone may sometimes be

removed without any external incision. Fig. 1, Pl. XXI, shows a case in which this operation was done by the late Dr. Horner, the portion of bone taken away being represented (on a very small scale) in Fig. 2.

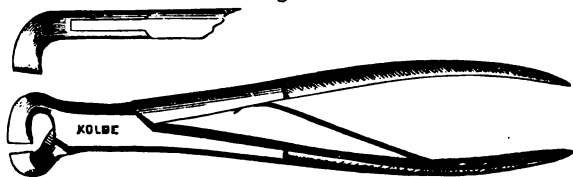
In order to accomplish this object, the patient being chloroformed, and his head firmly supported, an assistant draws the upper lip and cheek away from the bone, for which purpose one or two wide metallic retractors will answer best. The surgeon now dissects away the cheek from the maxilla, beginning in front and working round toward the side, until he has exposed the anterior and lateral faces of the bone, and divided all the soft tissues as far as necessary; he next separates as much of the bone as he intends to remove, in the same method as when external incisions are made.

Resection of the lower jaw-bone, either wholly or in part, is sometimes rendered needful by necrosis, or by tumors. The general principles of the operation are, to avoid unnecessary external incisions, and to so arrange the cuts that the cicatrices shall either be out of sight, or correspond as nearly as possible to the natural lines and creases of the skin.

Fig. 4, Pl. XXI, shows in rough outline a tumor seated on the anterior part of the lower maxilla, removed by making a section of the bone shaped as seen in Fig. 5.

The plan of incision, on a line parallel with and a little posterior to the edge of the chin, turning upward at either end, and the way in which the flap so made can be raised, may be seen in Fig. 6. The hands of an assistant are seen holding up the flap, on the inner or posterior surface of which the line of the mouth is shown, at 1—2.

Fig. 65.



A very convenient form of cutting forceps, especially adapted to the removal of the alveolar portion of the jaws, has lately been devised by Dr. D. H. Agnew of this city, and is shown in Fig. 65.

Plate XXI.

Fig. 1.



Fig. 3.



Fig. 2.



Fig. 6.

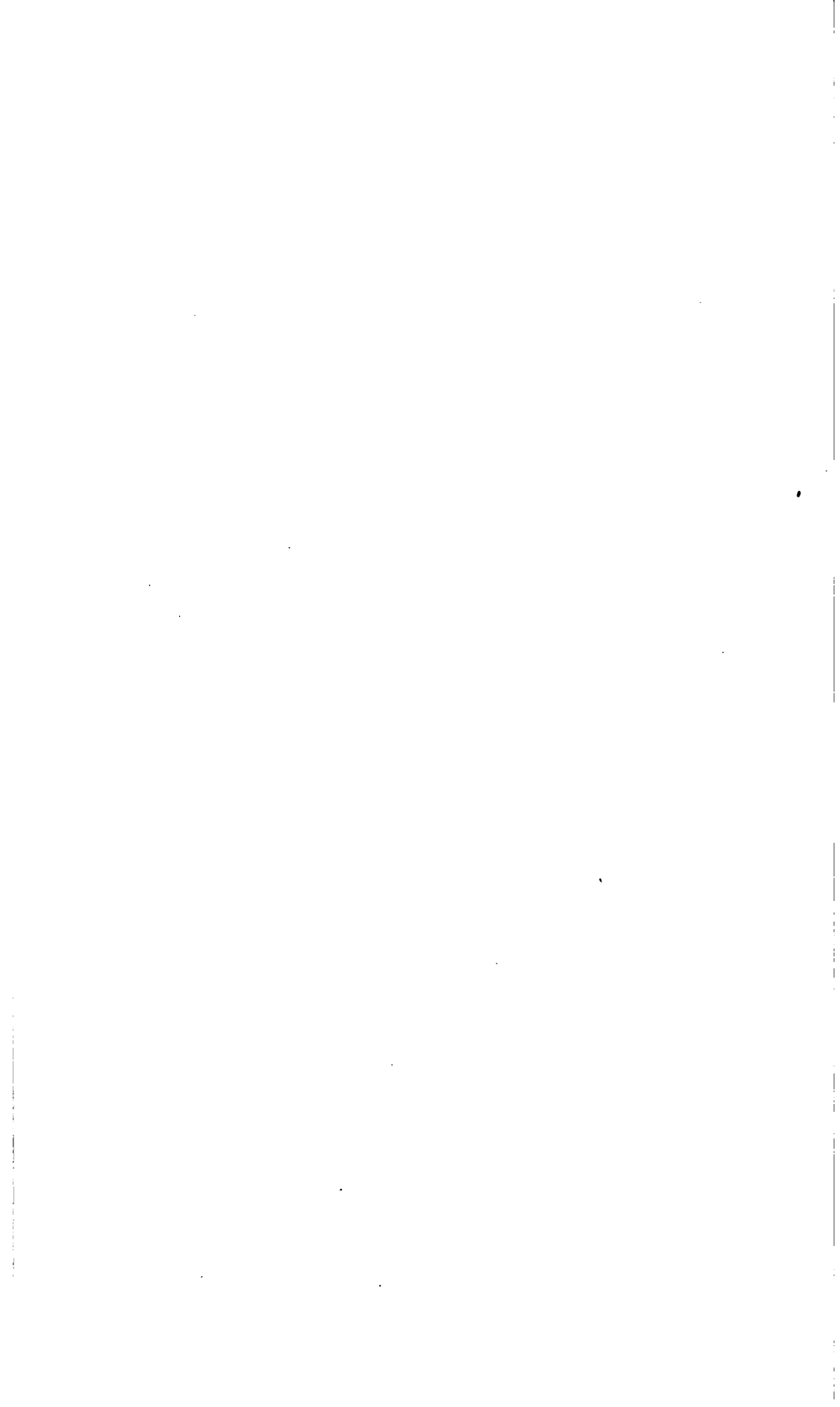


Fig. 7.



Fig. 5.









covers more or less all the large arteries of the neck, furnishes an important landmark in finding them, and must almost always be either held aside or divided in operations upon them.

In the anterior of these two triangles we find several subdivisions, also triangular. Above, we have a space, *a*, comprised between the edge of the lower jaw and the two portions of the digastric muscle. Below and behind this, is another space, *b*, limited by the edge of the sterno-cleido-mastoid, the posterior belly of the digastric, and the anterior part of the omohyoid muscles. Below, and in front of this, again, we have a space, *c*, bounded by the omohyoid and sterno-cleido-mastoid muscles, and the median line.

The posterior triangle of the neck is divided into two portions by the lower posterior part of the omohyoid muscle; of these the inferior, *e*, bounded by the sterno-cleido-mastoid and omohyoid muscles and by the clavicle, is by far more important than the upper, *d*.

The parts contained in these divisions will be indicated in connection with the various operations to be performed upon them.

When the skin, superficial fascia, and platysma-myoid muscle have been dissected off, we have exposed, as in Fig. 2, the most superficial of the important cervical vessels,—the external jugular vein.

This vein receives the main part of the blood from the outside of the cranium and from the deeper portions of the face; beginning in the substance of the parotid gland, 11, as the continuation of the temporo-maxillary and posterior auricular veins. It is usually single, as represented in the plate, but sometimes double. Near the angle of the jaw it receives a large communicating branch from the internal jugular.

The course of the external jugular vein is downward across the sterno-cleido-mastoid; at the outer edge of the attachment of this muscle to the clavicle it runs backward to empty into the subclavian vein.

In operations on the neck the external jugular vein must never be disregarded; it is either held aside with a blunt hook, or tied at two points and cut across between them.

Fig. 3 shows the deeper vessels of the cervical region. The sterno-cleido-mastoid muscle has been cut across, and, with the external jugular vein, is held aside by the hook, 14. The omohyoid muscle, 2, is seen running downward and outward across the internal jugular vein, 4. The latter is seen uniting with the subclavian vein to form the innominate. (This arrangement, unlike that of the arteries, is the same on both sides.) Beneath the omohyoid muscle, and lying on the anterior face of the transverse processes of the cervical vertebrae, the common carotid artery, 5, and the internal jugular vein, 4, are seen. The vein is outside, the artery inside; behind and between them lies the pneumogastric nerve.

Opposite the hyoid bone the common carotid artery bifurcates, forming the external and internal carotids.

In Fig. 4 is shown the anterior aspect of the neck, with special reference to the veins. These are the anterior, external, and internal jugular veins and their connecting branches.

1, 1, lower jaw; 2, hyoid bone; 3, 3, internal jugular vein; 4, omohyoid muscle; 5, position of larynx; 6, sterno-hyoid muscle (the omohyoid being cut off); 7, 7, anterior jugular veins; 8, 8, branches from these to 9, 9, ex-

Fig 1

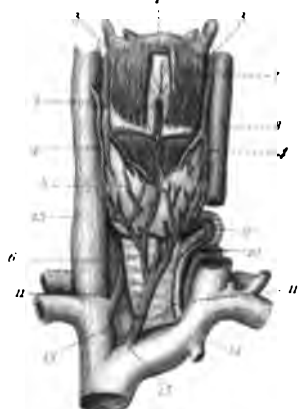


Fig 2



Fig 3



Fig 4



Fig 5



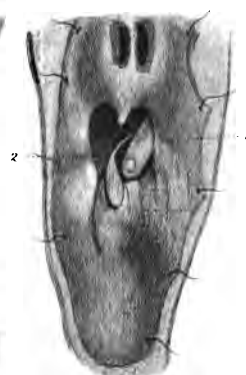
Fig 7



Fig 6



Fig 8



ternal jugular veins. 10, large communicating branch between the anterior jugular veins; sometimes there are several such.

Fig. 5 exhibits the relations of the œsophagus as seen from the left side. The carotid artery, 1, and internal jugular vein, 2, are seen held aside with a blunt hook. Anteriorly, the thyroid body, 3, is likewise held aside, exposing a small portion of the trachea, 4, and the œsophagus, 5.

(2) **Tracheotomy.**—This operation, in a majority of the cases requiring it, must be done without anæsthesia, the respiratory function being already interfered with, so that there would be risk of suffocation during the stage of excitement.

Sometimes, when suffocation is imminent (as for example from œdema of the glottis), the surgeon must instantly cut into the trachea, and the ordinary rules are set aside; a pair of forceps being pushed into the incision and the blades then opened, so as to distend the air-tube temporarily for the access of air to the lungs.

When a more deliberate procedure can be adopted, the operation consists in three steps: the exposure of the trachea, the incision into it, and the insertion of the tracheotomy-tube.

Surgical Anatomy.—The surgical anatomy of the trachea is shown in Fig. 1, Pl. XXIII. The hyoid bone, 1; below this is the thyroid cartilage, 2, in great part covered on either side by the thyro-hyoid muscles, 3, 3. Just below this, and covering the cricoid cartilage so as to conceal it, are the crico-thyroid muscles, 4, 4. Below these, the thyroid body (sometimes called gland), 5, covers the upper rings of the trachea; over its surface are seen several large venous twigs passing downward to form by their union the inferior thyroid vein, which at 13 empties into the left innominate vein, 14.

Between the lower edge of the thyroid body and the innominate vein are seen several rings of the trachea; and it is here that the tube is generally laid open by operation.

On either side of the larynx and trachea are large vessels.—*Veins.* The right internal jugular, 15, is seen receiving the superior thyroid vein, and running downward to be joined by the right subclavian, to form the right innominate. On the other side, the vein has been cut off just above the junction. The vein accompanying each inferior thyroid artery is seen emptying into the corresponding innominate vein.—*Arteries.* The primitive carotids run up on each side of the trachea, getting farther and farther back in relation to it as they ascend; they are also wider apart above. The superior and inferior thyroid vessels are seen running downward and upward on each side.

The line, 11, 11, shows the upper edge of each clavicle, and the interclavicular notch, with its relation to the trachea.

Fig. 2, a further dissection, shows the larynx, trachea, and large vessels. The hyoid bone, 1, is connected by the thyro-hyoid membrane, 2, to the thyroid cartilage, 3; which latter is connected by the crico-thyroid membrane, 4, with

the cricoid cartilage, 5. Below this is the trachea, 6. The large vessels are seen on either side of the lower part of the tube, as described in connection with Fig. 1.

Fig. 3 shows a plan of the large arteries and veins at the root of the neck. The arteries are here, as always, deeper than the veins; and the difference between the arrangement of the arteries of this region and that of the veins is readily seen.

Operation.—The surgeon must be so placed as to command a perfectly accurate view of the front of the patient's neck; and the light must be good. The patient, if a child, should be so firmly wrapped in a sheet or blanket that a steady assistant can take it on his knees and hold it in position; if an adult, should either lie on a table or sit in a strong-backed chair, well supported by an assistant standing behind him. In either case the shoulders must be raised and the head well thrown back. One assistant is generally required to hold the head. Another keeps the sides of the wound apart with two blunt hooks. Another hands the instruments, ties the vessels, and sponges out the wound.

The instruments required are: a scalpel, forceps (artery, dissecting and bull-dog), double hook, scissors, two tenacula, two blunt hooks, ligatures, sponges, long curved forceps for extracting foreign bodies, and a double tracheal tube.

(1) The skin is always to be divided as accurately as possible in the median line, from a little below the cricoid cartilage to within an inch of the sternum. Any vessels that are cut should be tied, as it is very important to avoid bleeding, not only lest the parts be obstructed, but lest the blood should get into the air-passages. The surgeon comes next to the space between the sterno-hyoid muscles (and sterno-thyroid, which are just beneath). Working down through this, he comes upon the trachea, the thyroid body being held upward, if necessary, with a blunt hook.

(2) All bleeding being checked, a tenaculum is hooked into one of the upper of the exposed rings, and the tube slightly drawn upward and forward so as to steady it, while a bistoury is entered through one of the lower spaces, its edge upward, and then, the handle being depressed so as to bring the edge forward, is carried firmly and steadily upward so as to divide three or four rings with the intervening membranes. As soon as the bistoury has entered, the head should be brought somewhat for-

ward, so as to lessen the risk of cutting the posterior wall of the canal.

(3) The trachea being still steadied with the tenaculum, the double tracheotomy-tube (Fig. 66) is insinuated through the opening and slipped into place.

Fig. 66.

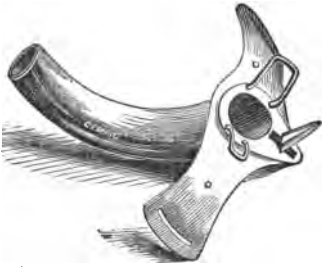


Fig. 67.



The tracheotomy-tube is generally made of silver, or plated, and must vary somewhat in size; it is double, so that the inner one (Fig. 67) may be taken out and cleaned. To prevent the accidental displacement of the inner tube, a small catch is provided.

(On an emergency, a pair of hooks might be made of wire, to hold apart the edges of the slit in the trachea, by means of a tape tied at the back of the neck.)

Several very small bits of fine sponge, on slender handles of twisted wire, should be kept at hand for the purpose of removing mucus, etc. from the inner tube without taking the latter out.

Upon respiration being fully established through the tube, the venous congestion of the neck generally ceases, and there is no more hemorrhage. The tube is fastened in place with tapes around the neck, as in Fig. 6, Pl. XXIII. By some surgeons a small "breathing-veil" of light gauze is laid lightly over the orifice to prevent the entrance of dust or other bodies floating in the air; but watchfulness and frequent cleansing of the tube will better answer the purpose.

Sometimes in a day or two the neck swells greatly, and the surgeon finds it difficult to reintroduce the tube if it must be taken out entirely for the purpose of cleansing it. It is then necessary to get a longer tube, and it is well to have a wooden plug or guide within this, projecting beyond it, to be removed as soon as the tube is in place.

Fig. 5, Pl. XXIII, shows the hand of the surgeon, he standing above the head of the patient, who lies on a table, with-

drawing by means of forceps a foreign body from the trachea. The lips of the wound are held aside with blunt hooks.

(3) **Scarification of the glottis.**—This operation, by no means an easy one, is sometimes required in cases of œdema threatening suffocation. Fig. 7, Pl. XXIII, shows the swollen parts, and the narrowing of the usually wide space between the epiglottis in front and the upper edge of the thyroid cartilage on either side. In Fig. 8 the left forefinger of the surgeon is seen at 1, acting as a guide for the long bent knife, 2, which is carried down upon the swollen tissue and made to score it.

In principle, this procedure is the same as that of scarifying the swollen conjunctiva or gums; the difficulty is in reaching the affected part.

(4) **Ligation of the facial artery** is very seldom required, but may be readily done at the point where it crosses the edge of the jaw, by an incision about an inch in length. (Pl. XXIV, Fig. 1, F.) No special directions need be given.

The head is turned toward the opposite side. One assistant gives the anæsthetic, two others separate the lips of the wound and sponge it out.

§ VIII. LIGATION OF ARTERIES IN THE NECK.

(1) **Ligation of the lingual artery** may be done for hemorrhage after operations on the tongue, or for wounds of the floor of the mouth, as in cases of cut throat; but it is so difficult, owing to the depth and frequent irregularities of the vessel, and the complexity of the surrounding parts, that most surgeons would probably prefer tying the common carotid.

The head is to be thrown back and toward the opposite side. The duties of the assistants are the same as in ligation of the lingual.

A transverse incision from the hyoid bone to the edge of the sterno-cleido-mastoid muscle (Pl. XXIV, Fig. 1, L) is made, and the platysma-myoid muscle and fascia beneath it divided, when the upper edge of the tendon of the digastric comes into view. The artery lies in a small triangle, formed above and in front by the edge of the mylohyoid muscle, below by the tendon of the digastric, and above and behind by the hypoglossal nerve. A small grooved director may be inserted beneath it, and a blunt needle strongly curved, or a piece of looped wire, used to carry the ligature.

Plate XXIV.

Fig. 3.

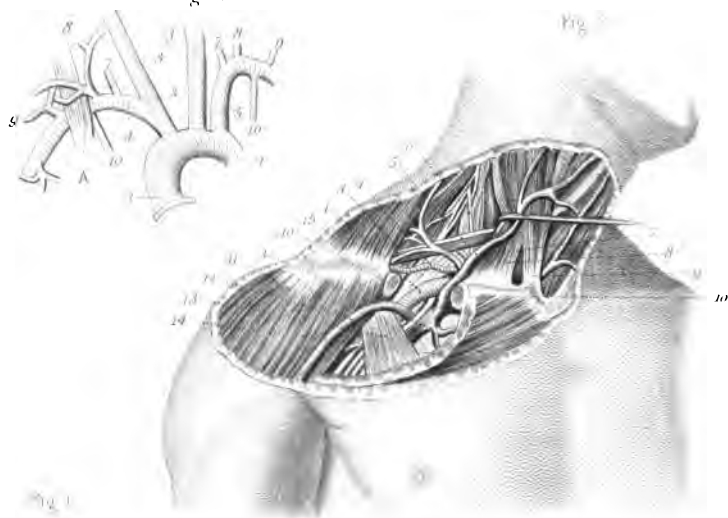


Fig. 1

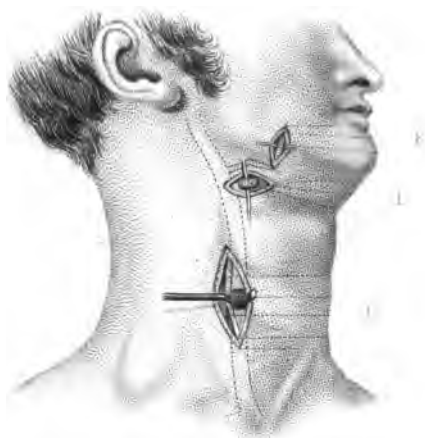


Fig. 6



Fig. 4

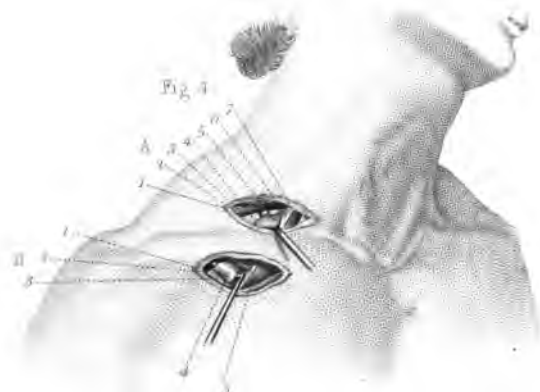


Fig.



(2) **Ligation of the common or primitive carotid artery** is not unfrequently needful for aneurism, for wounds, or even for morbid growths. (For Surgical Anatomy, see p. 75.)

The patient is laid on a table or firm bed, the shoulders raised, the head thrown backward and the chin turned well over toward the opposite side. The assistants are to perform the same duties as in the other cases just mentioned; but the lips of the wound should be held apart with spatulæ or metallic retractors.

An incision about three inches long is made, with the anterior edge of the sterno-cleido-mastoid muscle as a guide. Any veins in the way are divided and immediately tied, unless they can be drawn aside with the skin. The fascia should be next raised up, nicked transversely, and divided on a director. By repeating this process, the muscles and skin being carefully retracted, the sheath of the vessel is presently exposed. Upon it lies the loop of the descendens noni nerve, which is to be carefully retracted inward, the sheath being divided external to it. If now, the sheath being opened, the internal jugular vein bulges forward, it is compressed above and below, and the surgeon at once passes the aneurism-needle, armed with its ligature, beneath the artery, from without inward. By hugging the vessel closely, there is very little risk of including the pneumogastric nerve, which lies behind and between the artery and vein; but its presence should always be remembered.

Upon the tightening of the ligature, a convulsive seizure, more or less marked, is apt to occur; but it passes off soon.

(3) **Ligation of the subclavian artery.**—This very grave operation is generally done for aneurism.

Surgical Anatomy.—The anatomy of the subclavian and axillary arteries is shown in Fig. 2, Pl. XXIV. The clavicle has been partly removed. 1, subclavian artery, becoming axillary as it passes out from beneath the clavicle. 2, subclavian vein, likewise becoming axillary; the external jugular vein is seen emptying into it. 3, brachial plexus of nerves. 4, suprascapular artery passing outward across the neck. 5, omohyoid muscle. 6, phrenic nerve, lying on the anterior scalenus muscle. 7, external jugular vein, which, with 8, the sterno-cleido-mastoid muscle, is held aside with a blunt hook. 10, 10, sections of the clavicle. 11, deltoid muscle. 12, cephalic vein, running down at the anterior edge of the deltoid. 13, pectoralis minor muscle. 14, pectoralis major muscle partly cut away.

Fig. 3 is a diagram of the great vessels at the root of the neck. 1, 1, aorta; 2, innominate artery, bifurcating into the right common carotid, 3, and right sub-

so as to give access to the space at the inner side of the scalenus.

The uniform fatality which has attended this procedure may be said to have excluded it from the practice of judicious surgeons.

(4) **Ligation of the innominate artery.**—This artery has been tied a number of times, but only once with any success, and then the ligature was put on so as merely to flatten the vessel, in a case of hemorrhage from the carotid.

Surgical Anatomy.—It will be remembered that the innominate exists on the right side only, and runs upward from the arch of the aorta to the upper border of the right sterno-clavicular articulation. The inferior thyroid veins and the left innominate vein lie in front of it near its root, and it is close to the pleura and right pneumogastric nerve.

Operation.—The patient lies on a firm table, with his shoulders raised and his head thrown back. The duties of the assistants are as before, except that the shoulder is not to be depressed.

The surgeon stands on the patient's right side, facing him; makes one incision about three inches in length along the inner border of the right sterno-mastoid muscle, and another about of equal extent along the upper edge of the right clavicle; divides the muscle so as to reflect it upward, and then cuts in like manner through the sterno-hyoid and sterno-thyroid muscles. The inferior thyroid veins are now exposed, and must be drawn aside with a blunt hook, when a dense fascia upon which they lie can be cautiously scraped through, and the right carotid artery reached; following this down, we come to the innominate. The left innominate vein must be drawn downward.

The aneurism-needle is entered at the outer side of the artery, between it and the right innominate vein and right pneumogastric nerve; and is kept close to the artery in going round it, so as to avoid the right pleura and the trachea.

(5) **Œsophagotomy.**—This operation may need to be done for stricture, or for the removal of a foreign body. Fig. 6, Pl. XXIV, exhibits the method of performing it.

Surgical Anatomy.—The œsophagus lies behind the trachea, close to the cervical vertebræ, a little to the left of the median line. Unless distended by an instrument or a foreign body, it is quite flaccid, and could not be readily opened in the living subject.

Operation.—This does not differ materially from that for ligation of the common carotid. Unless there is a marked prominence, as from a foreign body in the tube, on the right side, the left is chosen. An incision is made, of about three inches in extent, along the margin of the sternocleido-mastoid muscle, about opposite the cricoid cartilage. The tissues are divided on a director, until the omohyoid muscle is reached; this is drawn downward, the trachea forward, the vessels outward. The superior thyroid, if it cannot be drawn upward, must be tied in two places and divided between them.

If now there is any difficulty in finding the œsophagus, a ball-probang should be passed down through the mouth, so as to distend it; and a longitudinal incision may then be made in it, long enough to admit the finger. Should it be needful to enlarge the wound subsequently, a probe-pointed bistoury is to be used for the purpose.

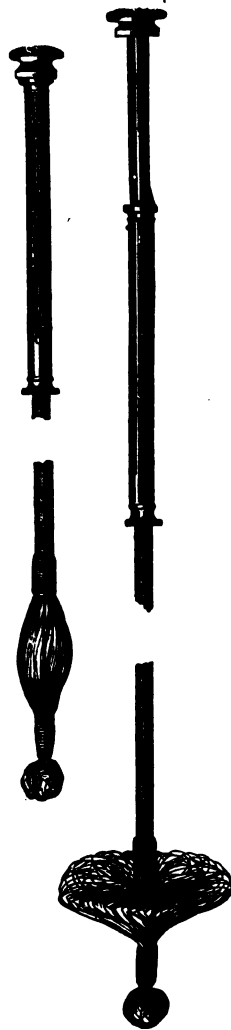
The wound readily heals, without any suture, if the neck is kept at rest. For a few days the patient must be fed either by passing a rather small sized stomach-tube, or by enemata of beef-tea, egg and brandy, milk; etc. •

If, as in cases of stricture above the point of section, a fistula is to be established, this may be done by keeping a tube in the opening, as in other regions.

Removal of foreign bodies.—For the removal of foreign bodies, a probang with a recurved catch may be used; or a bristle probang, introduced closed, as in Fig. 68, beyond the foreign body, and then expanded, as in Fig. 69, so as to engage it and bring it out. The expansion is effected by drawing out the slide attached to the button at the extremity of the handle.

Fig. 68.

Fig. 69.



CHAPTER III.

OPERATIONS ON THE THORAX.

§ I. AMPUTATION OF THE BREAST.

With a few rare exceptions, it is in females that this operation is necessary. We are not here concerned with the subject of the diagnosis of the tumors for which it is done, nor with the equally important question as to the amount of benefit conferred by it; but may remark that, once decided upon, it should not be needlessly delayed.

Operation.—The patient should be etherized, lying on a firm bed or table, with the diseased part in a good light, and the arm raised to at least a right angle with the body. The assistant who gives the anæsthetic can generally support the arm in this way, with one hand at the bend of the elbow.

The steps of the operation are: the incision of the skin and subcutaneous tissue; the enucleation of the entire gland and any diseased structures in its neighborhood; the arrest of bleeding; and the closure of the wound.

The instruments needful are: two or three scalpels; dissecting-forceps; artery-forceps and tenaculum; vulsellum forceps; scissors; two blunt hooks or spatulæ; ligatures; suture-needles and sutures.

The operator, standing or sitting at the side of the patient, makes the lower incision first, and then the upper; taking care to leave enough skin to come together well after the removal is completed (Pl. XXV, Fig. 1). (Operations sometimes succeed well even when the edges cannot be approximated, the wounds healing by granulation; but this should if possible be avoided.) Any vessels which spring may either be tied at once, or temporarily secured with catch-forceps, to be subsequently attended to.

By means of the knife-handle, delicate touches of its edge, and his fingers, the surgeon next separates all the areolar tissue connecting the tumor with the surrounding parts, drawing it out with his left hand, as in Fig. 2, or by means of the vulsellum

Fig. 1.



Fig. 2.



Fig. 3.

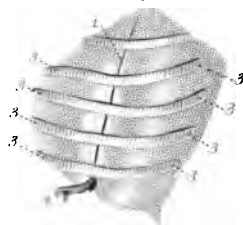
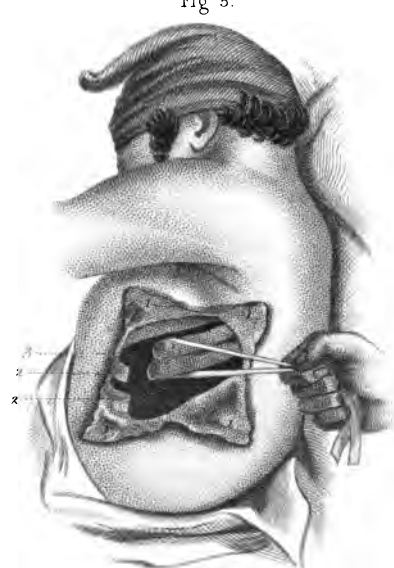


Fig. 4.



Fig. 5.



forceps. With the fingers as well as the eye, he now carefully explores the wound, to ascertain that all the disease is removed. Should the axillary glands be enlarged, it is better to take them away, even if the wound has to be extended for the purpose.

All the divided vessels should next be secured, either by acupressure or by ligation; the edges of the wound brought together with sutures and adhesive strips, or with adhesive strips alone, as in Fig. 3, and the protective dressings, dry, wet or unctuous, as the case may be, applied. Finally, the arm should be lightly confined in an easy posture.

§ II. PARACENTESIS THORACIS, OR TAPPING OF THE PLEURAL CAVITY.

This operation is done for the evacuation of pus or puruloid fluids, or sometimes of serum, as the result of chronic pleurisy. It is very simple, and is generally rendered easy by the bulging of the intercostal spaces. The point to be selected is between the eighth and ninth ribs, a little in front of the angle of the scapula.

Operation.—The patient is placed in a sitting posture, well supported, leaning backward, and turned somewhat away from the surgeon; who either plunges at once a trocar and canula through the skin and deeper tissues into the pleural cavity, or makes a preliminary incision an inch or less in length, as seen in Fig. 4, Pl. XXV. The point of the trocar is in either case entered at a right angle to the chest-wall, and then elevated by depressing the handle, so as to avoid any chance of wounding the pulmonary pleura.

Sometimes a syringe, having a pipe fitting accurately to the canula, is used to draw off the liquid. This pipe has a stop-cock, and at right angles to it another pipe, also furnished with a stop-cock; the first is opened and the second closed, while the syringe is being filled, an assistant holding it perfectly steady by means of a cross-bar. Now, the first stop-cock being closed and the second opened, the liquid is discharged into a basin or other receptacle. This process may be repeated until the pleura is as nearly emptied as is deemed necessary; but under no circumstances should air be allowed to enter the cavity.

§ III. RESECTION OF ONE OR MORE RIBS.

This operation is sometimes necessary, as for example in cases of necrosis, and consists simply in reflecting flaps of skin so as to expose the affected bone or bones, which are then sawed through with Hey's or a chain-saw, or cut with bone-nippers; after which they can be drawn outward, as in Fig. 5, Pl. XXV, and another section made in the same way at a point farther back, so as to take away as large a portion as is deemed proper. Hemorrhage will not be likely to occur to a troublesome degree.

CHAPTER IV.

OPERATIONS ON THE ABDOMEN.

§ I. PARACENTESIS ABDOMINIS.

TAPPING of the abdomen is not unfrequently necessary for the relief of ascites, or an accumulation of serum in the peritoneal cavity. It is done with a large trocar and canula; the liquid to be drawn off is often too thick to pass readily through a small instrument, and the operation would be unnecessarily tedious.

Operation.—The patient is seated on the edge of a chair or bed; a sheet or wide piece of muslin is torn into strips about three inches wide, from either end, to within two feet of the middle, thus leaving a central portion four feet across, which is placed in front of the abdomen, and the pairs of ends successively crossed behind the back. Now the trocar is entered either in the median line, below the umbilicus, or at the middle point of a line drawn from the umbilicus to the anterior superior spine of the ilium; a hole being cut in the muslin at whichever point is chosen. The trocar being withdrawn, the liquid flows out through the canula, and the abdominal walls are supported by two assistants drawing on the ends of the bandage behind.

Should the patient become faint, the flow of liquid may be temporarily checked, and a little wine or brandy administered. The bandage is kept applied for a few days.

§ II. ABSCESS OF THE LIVER.

When abscess of the liver is clearly diagnosed, it is of course desirable to evacuate the matter externally. But if a puncture be made, the abdominal wall and the liver being separate, the pus will flow into the cavity of the abdomen, and excite dangerous peritonitis. Hence it has been proposed to apply a cautery to the skin around the proposed point of operation, so

as to induce adhesion between the opposed surfaces of peritoneum, and enable the incision to be safely made a few days afterward. Fig. 1, Pl. XXVI, shows the eschar, the knife entering through it, and the pus escaping.

§ III. GASTROTOMY.

This very difficult operation is sometimes rendered necessary by stricture of the œsophagus, the idea being to establish a fistulous orifice into the stomach for the introduction of food, etc.; or for the removal of bodies swallowed. It has never yet been done with permanent advantage in cases of disease, the longest duration of life after it having been twelve days; but it may afford a faint chance in cases in which death is otherwise inevitable, and perhaps a greater degree of success would be attained, were it resorted to earlier than it has been heretofore.

Operation.—The following was the procedure employed by Dr. F. F. Maury, of this city, in a case which occurred in his practice in 1869. An incision about seven inches long, slightly curved, with its convexity outward, was made from near the sixth costal cartilage to a point an inch and a half above and to the left of the umbilicus. The fascia and sheath of the muscle having been divided, the muscular substance was torn through with the finger. (It would, perhaps, have been better to have found the outer edge of the muscle and drawn it inward.) Next, the tendon of the internal oblique and transversalis was divided, with the transversalis fascia; the peritoneum was thus exposed, and carefully incised, the precaution being taken of having the whole abdomen below compressed, in order to prevent the access of air to the peritoneal cavity. The stomach being now found, a silk ligature was passed through it, and the two ends confided to an assistant. Wire sutures were next passed through the wall of the stomach, including on either side the cut edges of the peritoneum and of the abdominal walls. An incision was now made into the stomach, and the middle portion of each of the wires just passed was pulled forward, and cut; by which each half of each wire was left simply penetrating the abdominal wall, the peritoneum, and the wall of the stomach; so that by twisting its ends together these structures were brought into apposition, and a gastric fistula provided for.

The patient lived only a few hours.

Plate XXVI.

Fig. 1.

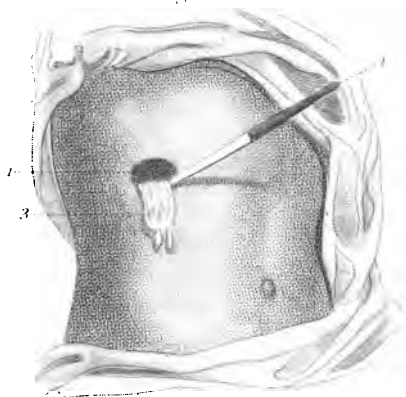


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.



§ IV. WOUNDS OF THE ABDOMEN.

When the abdominal wall is divided, as for example in cases of stabbing, and there is protrusion of one or more loops of intestine, it may be impossible to replace these without enlarging the wound. This is to be done as in Fig. 2, Pl. XXVI; the muscles being relaxed by flexing the thighs on the body, the intestines are gently held out of the way by the surgeon with his left hand, the forefinger of which serves as a guide for the probe-pointed knife in the right, and the incision is made to the extent needful. Or an assistant may take care of the protruded intestine, while the surgeon with his left hand introduces a grooved director, and along this the blade of the bistoury.

In closing the wound it is of importance to use the harelip or the quilled suture, so as to bring the deeper layers of the abdominal wall to unite; otherwise a ventral hernia would be very apt to occur at the seat of injury.

§ V. SUTURE OF WOUNDS OF THE INTESTINES.

From its greater mobility, as well as from its position in the abdomen, the small intestine is much more apt than the large to be protruded and wounded. It can only be sewed up if protruded, since the peristaltic action would otherwise speedily remove the injured part from the neighborhood of the parietal opening.

Longitudinal wounds may be sutured in two ways: (1) by means of threads which are left long, the ends brought out of the wound in the abdominal wall, and fastened so as to keep the gut in contact with the latter; (2) by means of stitches, the ends of which are cut off, to find their way into the gut and so escape with the feces.

In every case, the great object is to secure the contact of two serous surfaces; so to apply the suture, that the wall of the gut shall be turned inward at either edge of the wound.

One method is shown in Fig. 3, Pl. XXVI. Four sutures have been passed across the wound but not tied; they are gathered into a mesh, lightly twisted so as to bring the edges in contact, and brought out through the parietal opening. By placing due tension upon them and securing them thus to the skin with strips of sticking-plaster, we seek to obtain, first, the closure of

the intestinal wound, and secondly, for greater security, the adhesion of this part of the gut to the abdominal wall.

In a few days, the loops of suture will cut their way out, and may be very easily withdrawn.

Another method is shown in Fig. 4, Pl. XXVI. One thread only is used. The wound is sewed up by means of the ordinary continuous or glover's suture, and then the two long ends of the thread are brought out at the parietal opening, and secured as in the former case.

In Fig. 5, Pl. XXVI, is represented the method of Lembert, the sutures being entered say one-quarter of an inch from the edge of the wound, brought out again one-eighth or one-sixteenth of an inch from it, and carried across the gap; being then entered one-eighth to one-sixteenth of an inch from the other edge, and brought out at about one-quarter of an inch from it, the tightening and tying together of the free ends will obviously bring the serous or parietal surfaces together, and favor the occurrence of union between them.

Another method of suture of longitudinal wounds of the intestine is shown in Fig. 1, Pl. XXVII. A long thread, 1, 1, with a needle at either end, is passed across the line of the wound, a little beyond its extremity, as at 2, 2; it is then brought out as at 3, crossed, entered and brought out again as at 4, crossed again and entered, and so on. In this way the serous surfaces are brought together in the whole line of the cut; the ends are tied at their last point of crossing, and cut off close, to find their way into the gut by ulceration.

Reybard's method is seen in Fig. 2, Pl. XXVII. A small piece of wood or plate of lead, with two punctures close together, through which the ends of the suture thread are passed, is inserted in the intestine. By means of two needles the ends of the thread are brought out through either edge, first of the intestinal and then of the abdominal wound, to be tied externally.

Fig. 3, Pl. XXVII, shows Jobert's mode of suturing transverse wounds. This is to invaginate the upper portion of the gut in the lower, by passing a ligature through the edge of the former, and then bringing both ends out through the latter, from without inward, tying them together, and either cutting them off short or leaving them to hang out of the parietal opening.

Fig. 1



Fig. 3

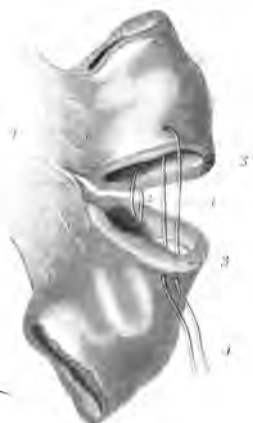


Fig. 2



Fig. 4

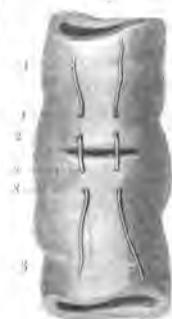


Fig. 5

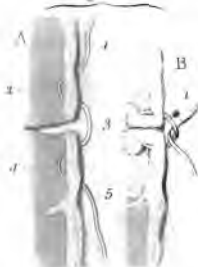


Fig. 6



Fig. 7



Fig. 8



Fig. 9



Fig. 10

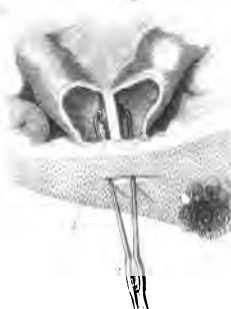


Fig. 11



Fig. 12



Figs. 4 and 5 exhibit the method known as Lembert's. The proper number of sutures are passed in and out at each edge of the wound, as in Fig. 4, or as seen in profile at A, Fig. 5. When tightened, as at B, Fig. 5, they are seen to bring together a small portion of serous surface of either edge. In this case they are cut off short, and passed away through the gut with the feces.

§ VI. OPERATION FOR THE CURE OF ARTIFICIAL ANUS.

Fig. 6, Pl. XXVII, shows an artificial anus, the upper and lower portions of the intestine communicating with the exterior by separate orifices. In Fig. 7 there has been an adhesion of the walls of the two portions, with closure of the distal or lower one, the septum between the two being complete. No fecal matter could pass this point, therefore, and the lower portion of the bowel would shrink away into a flaccid and undistended tube.

Fig. 8 shows a fully-formed artificial anus, the septum between the two portions of bowel being merely a crescentic fold of mucous membrane. The manner in which the peritoneum and surrounding tissues blend to form a funnel-shaped opening is also seen. 1, the pelvic peritoneum; 2, the upper, and 3, the lower portion of bowel; 4, the mesentery common to both; 5, the crescent-shaped septum; 6, the funnel-shaped tube of exit; 7, a probe passed into the bowel.

In Figs. 9 and 10 may be seen the manner in which the spur-like septum, which at first exists between the two orifices of a double artificial anus, becomes destroyed by ulceration, so that a portion of the fecal matters would be discharged here, and the remainder be carried along the lower part of the bowel. 1, the upper part of the bowel; 2, the lower; 3, the septum; 4, the mesentery. The arrows show the different course taken by the feces in the two conditions of the septum.

Operation.—This consists of two parts. First, if any septum exists between the two portions of bowel, it must be broken down, so as to allow of the feces taking their natural course.

Secondly, the abnormal orifice must be closed up by a suitable operation; its edges being freshened and caused to unite by means of sutures. Sometimes these procedures require very skilful plastic surgery. A most interesting and instructive case of this kind, in which the abnormal anus was the result of gun-

shot wound, was reported by Dr. William Hunt, of this city, in the Pennsylvania Hospital Reports for 1868.

In order to break down the septum, various devices have been employed.

That of Dupuytren, a pair of forceps or nippers with long and bluntly serrated blades, to grasp the tissues and cause their absorption by pressure, is shown in Fig. 11, Pl. XXVII. The instrument, when applied, is kept in position and in operation by a screw playing between the handles.

The forceps of Liotard, with long blades ending in a pair of accurately apposed circular plates, likewise held together by means of a screw, is shown in Fig. 12.

§ VII. HERNIA.

Hernia, or rupture, is a protrusion of a portion of the contents of the abdomen, at some point where the wall of that cavity is either naturally weak or has been accidentally weakened.

The naturally weak points in the abdominal wall are those where vessels pass out; the inguinal and femoral rings, the umbilicus, the thyroid and ischiatic foramina. Rupture of the muscles at any point may cause accidental weakening there.

Herniæ may be reducible, or irreducible; and in either case the tissues may so compress the protruded part as to strangulate it. We are here concerned with such cases only as call for operation; but it may be remarked that a patient with a reducible hernia is never safe unless a properly fitted truss is constantly worn to keep it reduced.

Herniæ are named according to the points at which they occur: inguinal, femoral, umbilical, obturator, ischiatic, or perineal; ventral, when they find issue through a loss of continuity in the abdominal wall.

They are also named in reference to their contents: enterocele, epiplocele, or entero-epiplocele, according as they consist of bowel alone, omentum alone, or bowel and omentum together.

Surgical Anatomy of Inguinal Hernia.—Inguinal hernia is that form which occurs just above Poupart's ligament, while femoral occurs below it.

Inguinal hernia, when it passes down through the abdominal canal, following the course of the spermatic cord, is called *oblique* or *indirect*; when it escapes at once through the external ring, without coming through the canal, it is called *direct*. These two forms, which will be explained presently, cannot always be distinguished from one another in practice.



Fig. 1

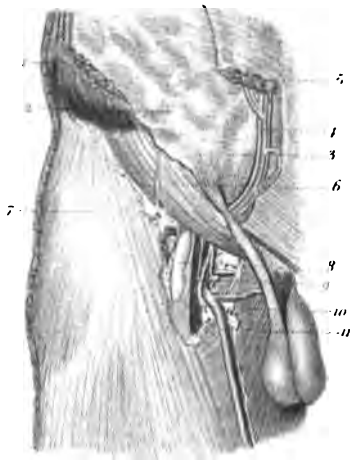


Fig. 2

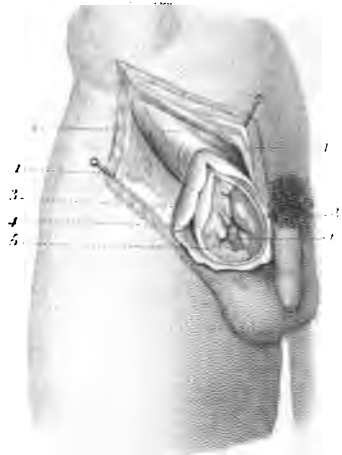


Fig. 3

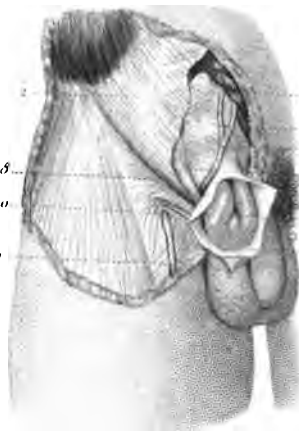


Fig. 4



Fig. 5



Fig. 6



Fig. 7



Fig. 8



The inguinal canal is a tube-like process of transversalis fascia, about an inch and a half long. When, after the seventh month of foetal life, the testicle descends from the lumbar region, it comes down along the psoas muscle, takes with it a double covering of peritoneum, pushes before it a glove-finger-like process of transversalis fascia, and several fibres from the lower edge of the transversalis and internal oblique muscles (which are here blended); it travels behind the external oblique tendon toward the median line until it comes to a triangular opening in the tendon, and then passes forward through this opening, taking another covering from the thin fascia (intercolumnar) which stretches across it. This triangular opening is called the external, or superficial *abdominal or inguinal ring*; the point where the process of transversalis fascia begins is called the internal, or deep, *abdominal or inguinal ring*. After the testicle has passed out of the external ring, it gets a covering from the superficial fascia and skin; while its vessels, nerves, and duct continue to occupy the canal.

When a hernia comes down through the canal, it will have the following layers of tissue as covering: skin, superficial fascia, intercolumnar fascia, cremaster muscle (the fibres derived from the blended internal oblique and transversalis muscles), transversalis fascia, and peritoneum.

Now this process of peritoneum constitutes what is called the hernial sac. The mode of its formation is shown in Fig. 6, Pl. XXVIII.

Fig. 7 shows how the bowel, once protruded, swells somewhat outside of the point when it escapes; while in Fig. 8 the sac is shown also.

Fig. 4 is a plan of the sac; 1, abdominal parietes; 2, neck of the sac; 3, its fundus; 4, its mouth; 5, cavity of the peritoneum.

Fig. 5 exhibits a sac of hourglass shape, formed as follows: through the abdominal wall, 1, 1, the original protrusion has taken place, forming the fundus, 2; a fresh protrusion, 3, has occurred, the original neck, 4, existing as a constriction between the two. The thickening of the sac at the narrowed portions is to be noticed.

Should a portion of bowel, or omentum, or both, come down along the canal, it lies in front of the spermatic vessels, nerves, and duct.

Direct inguinal hernia, much more rare than the indirect, is a protrusion through the external ring, with the same coverings as in the former case, except that we have the conjoined tendon of the internal oblique and transversalis muscles instead of the cremaster, and a new process of the transversalis fascia instead of the infundibuliform or tube-like process which forms the inguinal canal.

The great difference between these two forms of hernia is in their relation to the epigastric artery. This vessel, taking its origin from the external iliac just before it becomes the femoral, runs up behind and to the inner side of an oblique or indirect hernia, while it lies to the outer side of a direct one. Now the importance of this point is that an indirect hernia of long standing will gradually distend the parts just about its neck, until it assumes the appearance of a direct one; and thus in operating, if the stricture is divided inward, the epigastric artery may be cut.

In Fig. 1, Pl. XXVIII, the parts concerned are shown. The skin, superficial fascia, and muscles have been dissected away so as to show the transversalis fascia, 2, the commencement of the canal at the internal or deep ring, 3; the epigastric vessels, 4, running up behind the divided rectus muscle, 5

The lower part of the tendon of the external oblique is seen at 6, forming Poupart's ligament, just above which, at the external ring, 7, it is penetrated by the cord, 8.

Fig. 2 shows an oblique hernia, containing both bowel and omentum. The pressure of the tumor has widened the external ring, forcing its columns farther away from one another and enlarging it; and the inguinal canal itself is seen to be distended, the swelling causing the tendon of the external oblique to bulge, as at 2. The continuation of the wall of the inguinal canal, or process of transversalis fascia, over the tumor is seen at 3, 3; while the sac itself is shown at 4; the contents of the sac are the omentum, 5, and bowel, 6.

In Fig. 3 is represented a direct inguinal hernia. All the tissues overlying the sac have been dissected away, and two points must be especially noted. (1) One is that the inguinal canal, 4, lies at the outer and back part of the hernial tumor, instead of being bulged out by the passage of the latter through it; its contents are simply the constituents of the cord. (2) The other is that the epigastric artery, 6, runs up *back* of the inguinal canal and at the outer side of the neck of the hernial sac. It is perfectly obvious that in this case the relation of the artery to the hernial sac is very different from what it would be if the sac were contained, as in the oblique variety, within the canal.

The sac, 5, is widely laid open so as to show the contained intestine, 7.

Operations for inguinal hernia.—(1) *Taxis*, or reduction. This is very generally done by the patient himself, whenever he is about to apply his truss. It is always attempted by the surgeon before resorting to any other operative procedure for the relief of strangulation; and consists simply in emptying the sac by gently pressing its contents back into the abdominal cavity.

Entire relaxation of the parts must first be obtained, the shoulders and hips being raised so as to flex the body forward, and the knees brought up so as to slacken the anterior muscles of the thighs. (Formerly, it was advised to employ bleeding, tartar emetic, the warm bath, and enemata of infusion of tobacco, to do away with all tension; but these are needless since we have the far more efficient and agreeable means of anæsthesia by ether or chloroform.)

The surgeon now makes with one hand gentle and steady compression of the sac just at its neck, while with the other he exercises a proportionate force, also gently and steadily, upon the whole tumor. The success of this manœuvre is announced by a yielding, with a slight gurgling noise, and a more or less gradual softening, diminution and disappearance of the tumor.

The position of the hands in this operation is shown in Pl. XXVI, Figs. 6 and 7. Generally, it is more convenient to apply the left hand to the neck of the sac, while the right pushes the

Plate XXIX

Fig 2



Fig 1

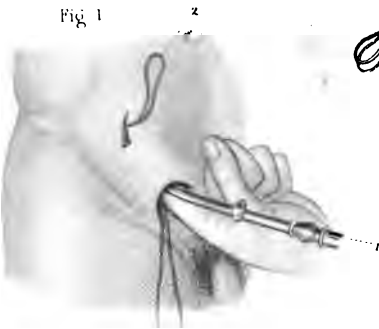


Fig 3

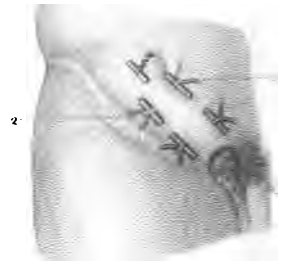


Fig 4

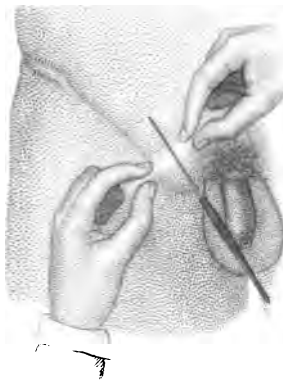


Fig 6



Fig 5

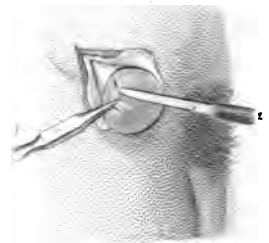


Fig 8

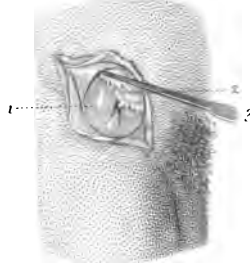


Fig 7

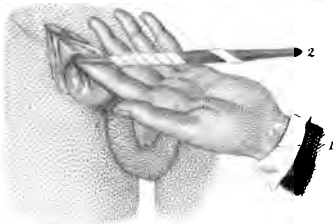


Fig 9



bowel up; but they may often be reversed, at least by a dexterous manipulator, without material disadvantage.

The surgeon must use his judgment as to how long the taxis should be persevered with; he should carefully avoid rough handling of the parts, and make his pressure as uniform as possible. When the experiment has been duly made, and has failed, and especially if there is vomiting of fecal matter, he must proceed at once to the last resource.

(2) *Postural Treatment*.—(A plan which is said to have succeeded in some cases of strangulation, when the ordinary taxis has failed, is to have the patient's position reversed; his knees being flexed over the shoulders of a strong man, who then stands up, the patient's shoulders remaining on the bed; the weight of the intestines will tend to drag the protruded portion back into the abdominal cavity.)

(3) *Herniotomy*, or division of the stricturing tissue. As a general rule, the seat of stricture is at or near the neck of the sac. The patient being in a state of anæsthesia, and the parts relaxed as for the taxis, an incision is made in the skin, Pl. XXIX, Fig. 4, and the subjacent tissues are successively pinched up, nicked, and divided upon a grooved director, Fig. 5, until the sac is reached. This is laid open, as in Fig. 6, and explored with the finger passed up to the seat of stricture; the intestine or omentum is drawn out a little to see what its condition is; a probe-pointed bistoury is next cautiously introduced alongside of the finger, Fig. 7, with its back to the bowel, until it is felt to be engaged against the stricturing tissue, against which the edge of the knife is pressed with a slight sawing motion, so as to divide it about one-sixteenth or one-eighth of an inch. This cut must be made directly upward, in order to avoid the epigastric artery, which comes off from the external iliac close to Poupart's ligament, and runs upward and inward. (If the hernia is clearly made out to be direct, which is very rarely the case, the incision may be somewhat upward and inward. In all cases of doubt, it should be upward.) The incision may be repeated at two or three points, if necessary; a single deep cut should never be made, lest the neighboring parts should be injured.

As soon as the stricture is completely relieved, the protruded parts are cleansed of blood, and examined to determine their condition, whether sound, congested, inflamed, or gangrenous; if not gangrenous, they are allowed to slip back into the ab-

dominal cavity; the wound is carefully sutured, a dressing, dry, wet, or unctuous, applied, the knees tied together, and the patient placed in bed in a relaxed position,—the shoulders raised, the thighs flexed on the abdomen, and a pillow under the knees.

Opium is freely given, in order to lock up the bowels for several days.

If the protruded intestine is gangrenous, it should not be returned, but an artificial anus should be allowed to form, in the hope that recovery may take place, and the condition be relieved by subsequent treatment. If the mortified protrusion consists of omentum, it should be ligatured tightly, and cut off.

By some surgeons, it is strongly advised that the stricture should be sought for before laying open the sac, and that, if it be found and divided, the sac should be returned unopened, with its contents. To do this with safety, however, it should first be ascertained that there is no stricture intrinsic to the sac, which, in such case, could be emptied by a procedure like the ordinary one of taxis. Otherwise, the protruded viscera may be pushed back into the abdomen, with the actual strangulation unrelieved.

After the operation of herniotomy has been successfully performed, and the wound healed, it is always necessary for the patient to wear a well-fitted truss for some time, if not permanently.

(4) *Operation for the radical cure of hernia.*—It would be beyond the province of the present work to discuss the various operations which have been devised for this purpose. Suffice it to say, that the principle is to carry up a doubling or pouch of the subcutaneous tissue along the canal by which the protrusion has occurred, and to fix it there until it becomes firmly adherent, so as to form a plug.

The cases especially suited for this operation are those of persons between puberty and middle age, who would be debarred from active pursuits in great measure, even with well-fitted trusses. In more advanced age the chance of success is not so good, and the object, if gained, of less importance. Hernia in children will often get well without any operation at all, by the mere pressure of the truss.

The following operation for the radical cure of hernia has proved very successful in my own and other hands in this city.

The patient being etherized, the parts are shaved, and an in-

cision about two inches in length made from above downward along the scrotum, beginning just below the level of the root of the penis. This incision involves only the skin and superficial fascia, which are dissected off from the dartos on either side, so that the latter can be invaginated by itself. The finger is now applied to the dartos, a pouch of which is pushed up well into the inguinal canal, but in such a way as to put no stress upon the tissues. Next, the surgeon substitutes for his finger the closed blades of an instrument such as is represented in Fig. 70. This is pushed up as far as possible, and the blades opened. Along one of its grooves the needle, Fig. 71, having

Fig. 70.

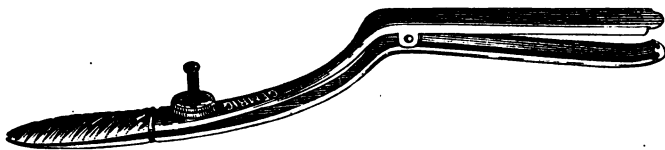
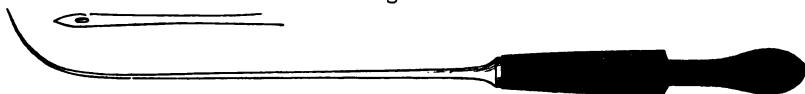


Fig. 71.



a fine iron wire passed through the eye near its point, is now passed, made to emerge through the skin, and withdrawn, leaving one end of the wire. Being again passed through the other groove, it is made to emerge at a point about half an inch from the first, Pl. XXIX, Fig. 2, and again withdrawn, leaving the other end of the wire, which is now tightened so as to fix the upper cul-de-sac of the pouch in the canal. Two double silk sutures are now passed across, between the blades of the guide, and tied over bits of catheter or rolls of lint. The wire suture is twisted over a similar pad, and the guide withdrawn, when the parts will have the appearance shown in Pl. XXIX, Fig. 3.

A wet lint dressing is now applied, and the patient put upon the free use of opium, to prevent any action of the bowels for several days. In about ten days the iron-wire suture may be removed; two or three days afterward, the upper silk suture, and finally, in two or three days more, the lower. A well-made suspensory, and a lightly pressing and well-fitted truss, should be worn for several months.

Figs. 1 and 2, Pl. XXIX, show the introduction of the needle, but without the guide. The use of the latter adds very greatly to the ease, safety, and certainty of the operation.

CRURAL OR FEMORAL HERNIA.

Surgical Anatomy.—In this form of hernia, the protrusion occurs just beneath Poupart's ligament, at the inner side of the femoral vessels.

Fig. 1, Pl. XXX, shows the skeleton of the parts concerned. Poupart's ligament stretches from 1, the anterior superior iliac spine, to 2, the symphysis pubis; at 3, the triangular process of it, known as Gimbernat's ligament, is seen; a fibrous septum, 4, extending from it to the brim of the pelvis, divides 5, the space for the passage of muscles, from 6, that for the femoral vessels. It is at the inner side of 6, between the vessels and Gimbernat's ligament, that hernia occurs.

In Fig. 2, the skin and superficial fascia having been dissected off, the so-called cribriform fascia is seen. This is a sheet of wide-meshed areolar tissue, containing a number of lymphatic glands, as well as small vessels; it begins at the fold of the groin above, and is lost on the front of the thigh below.

Fig. 3 shows the cribriform fascia dissected off and turned upward, so as to exhibit the falciform edge of the fascia lata of the thigh. Below this are the vessels, the artery outside, the vein inside; at 7, the saphena vein, 8, empties into the femoral.

In Fig. 4 the fascia lata has been removed, and the vessels are shown pushed a little outward by the protrusion of a loop of intestine. The sac is laid open, and the vein is seen to be somewhat overlapped by it. The relation of femoral to inguinal hernia is well displayed here; the former below Poupart's ligament, the latter above it, in the inguinal canal, 4.

Fig. 5 shows a double sac, a second protrusion occurring close to the first.

In Fig. 6 is shown a state of things more apt to occur in femoral than in any other form of hernia,—the nipping of a part only of the calibre of the intestine. It is very dangerous, since it is not likely to be recognized and relieved; two fatal cases of the kind have come under my own observation.

Fig. 7 shows the fascia lata turned upward, and held by a hook; the psoas magnus and iliacus muscles emerging beneath Poupart's ligament, the vessels on their inner side, with their fibrous sheaths; and the line of the incisions for exposure of the hernia when an operation is necessary.

Fig. 8 is a view of the inner face of the anterior wall of the abdomen, showing the bladder, 1, and the reflections of peritoneum from its upper surface over the round ligaments, 2, 3, and the urachus, 4. At 5, is seen the dimple or depression marking the point of exit of the spermatic vessels, or of an oblique inguinal hernia; at 8, the external iliac artery, and at 9, the vein, just before they pass under Poupart's ligament and become femoral.

Operations for femoral hernia.—(1) The *taxis*. This must be done on the same general principles as in the case of the inguinal form. But as the constricting parts are firmer and more resisting, the danger of strangulation is more imminent, and the attempt at reduction must be less persistent. It must also be remembered that, especially in cases of long standing, the hernial protrusion turns up over the anterior surface of the

Plate XXX.

Fig. 1.



Fig. 2.

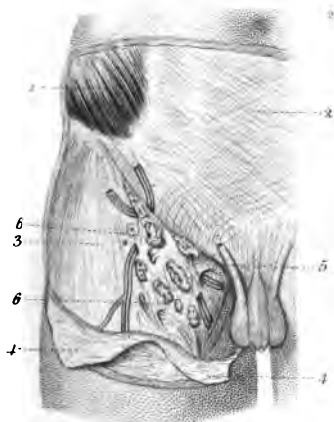


Fig. 3.

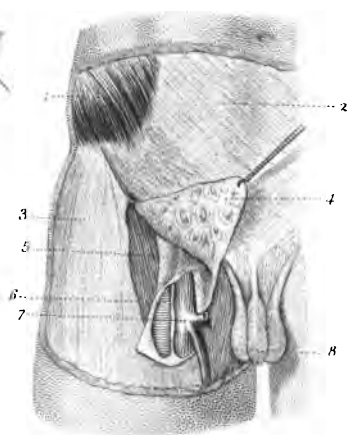


Fig. 4.

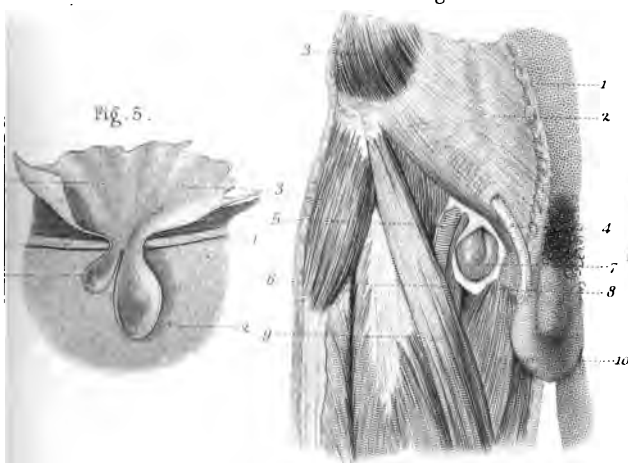


Fig. 5.

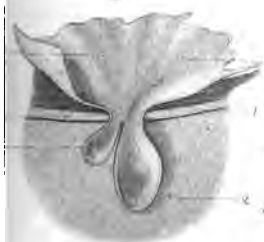


Fig. 6.



Fig. 7.

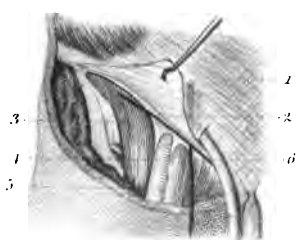
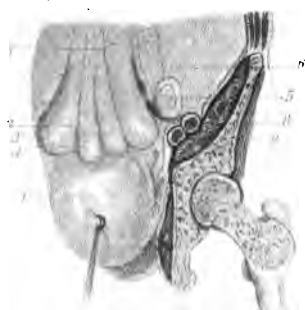
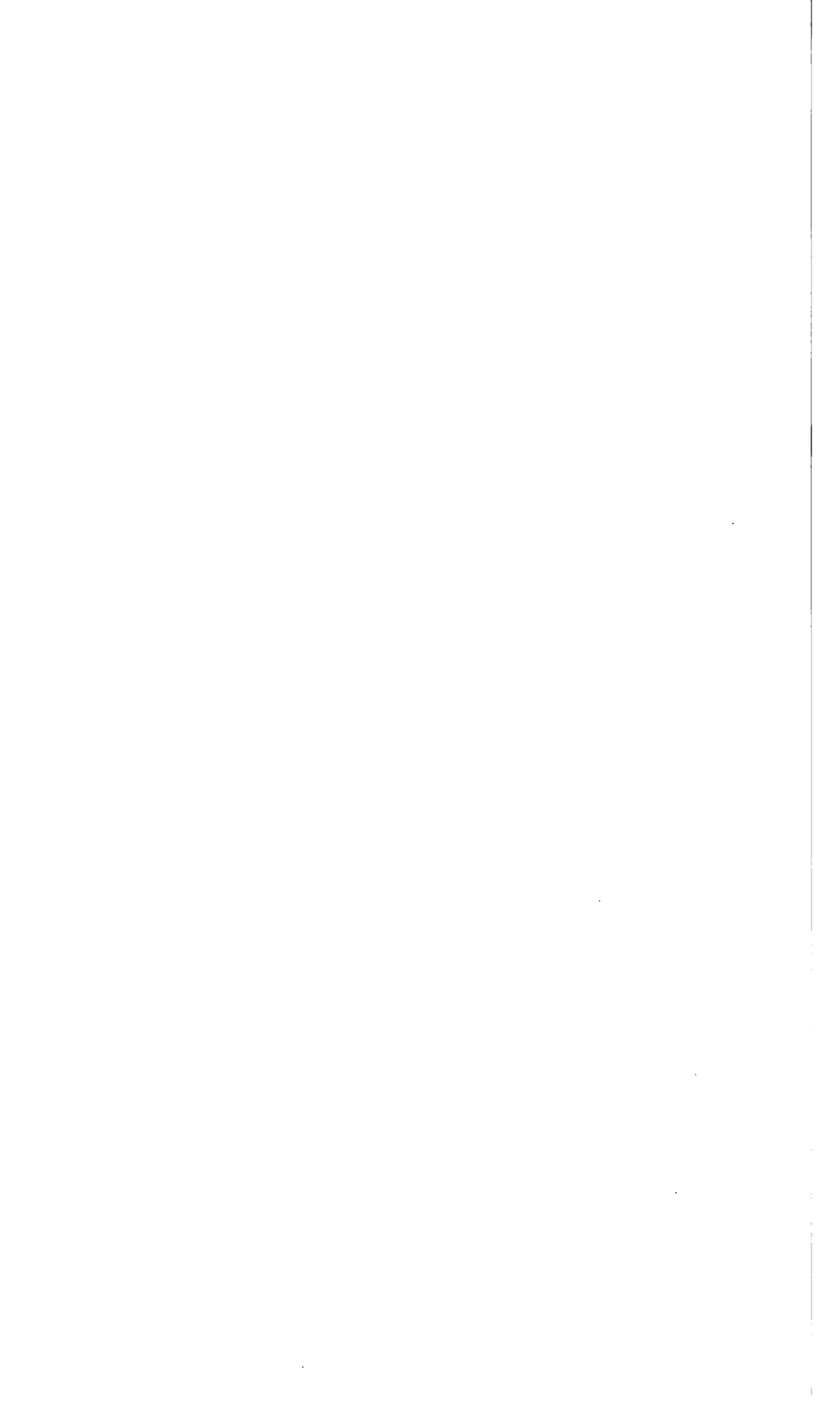


Fig. 8.





fascia lata, and the actual neck of the sac is more deeply seated, and higher up, than it would appear to be.

The postural treatment (see p. 97) may be employed here also.

(2) *Herniotomy*.—The best incision for the relief of strangulated crural hernia is shown in Fig. 7, Pl. XXX. It consists in dividing the skin first along the fold of the groin, or about half an inch below Poupart's ligament, and from the middle of this cut dropping another, as nearly as possible corresponding with the inner edge of the sheath of the vessels; if the pulsation of the artery can be felt, about half an inch to its inner side.

Two flaps of skin and superficial fascia can thus be turned aside, and the subjacent layers of tissue successively pinched up, nicked, and divided on a grooved director. The sac being reached and opened, the finger is passed up until the stricture is reached, when a probe-pointed bistoury or hernia knife is slipped along the finger and made to nick it. Almost always, the seat of stricture is at Gimbernat's ligament (Pl. XXX, Fig. 1, 3); and the edge of the knife should be turned *inward* against it. (If the division were made upward, both the epigastric artery and Poupart's ligament would be endangered.)

The examination of the protruded structures, and the subsequent treatment, are the same as in the case of inguinal hernia.

(3) *Operation for radical cure*.—This is both more difficult and less satisfactory than in cases of the inguinal variety. If attempted, the same general rules are to be followed as before laid down; there will be differences of detail, so obvious that space need hardly be taken up with them here.

Other forms of hernia,—umbilical, obturator, etc.,—sometimes become strangulated, and demand operation; but cases of the kind are very rare, and when they do occur, must be treated on the same principles as those already discussed. The modifications needful would be such as must naturally suggest themselves to those familiar enough with anatomy to undertake procedures of the kind.

§ VIII. COLOTOMY, OR THE FORMATION OF AN ARTIFICIAL ANUS.

This operation sometimes gives great relief in cases of stricture of the rectum; it may also be proper in cases of imperforate anus in new-born children, when the gut cannot be entered from the perineum.

Fig 1

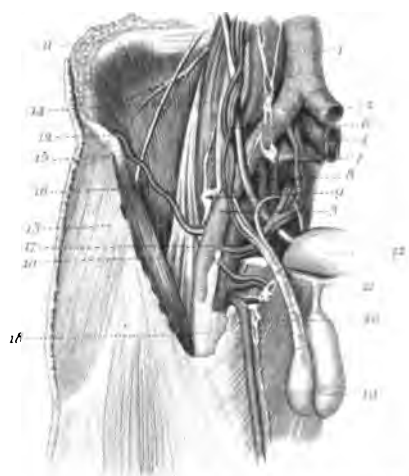


Fig 2



Fig 3



Fig 4

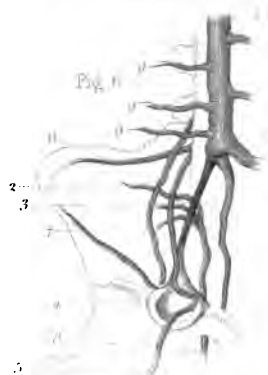
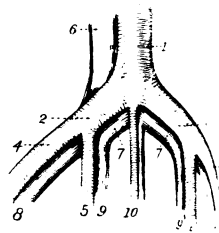


Fig 5



Fig 6



three to five inches. The muscles are divided carefully, the wound being held open by assistants, until the gut is exposed, when it is dealt with as in the former case. Two loops of thread are seen at 4, 4, Pl. XXXI, Fig. 4, passed through the walls of the bowel, so as to steady it while it is fixed to the edges of the wound and laid open.

§ IX. LIGATION OF ARTERIES IN THE ABDOMEN AND PELVIS.

Surgical Anatomy.—The aorta runs down somewhat to the left of the vertebral column, as far as the body of the fourth lumbar vertebra, where it divides into the two common iliacs. These vessels run downward and outward to the level of the brim of the pelvis, where each again bifurcates, forming the external and internal iliacs; the external passing on outward to escape under Poupart's ligament and become femoral, while the internal drops into the pelvic cavity to supply branches to the parts therein, to the generative organs, and to the inner side of the thigh.

Each external iliac vein, like the femoral, is situated close to the artery, at its inner side. The internal iliac veins also lie to the inner side of the corresponding arteries. On the left side the external iliac vein runs *behind* the internal iliac artery, and is joined by the internal iliac vein to form the left common iliac vein; this vessel runs upward and inward parallel with and close to the left common or primitive iliac artery, and passes under the right common iliac artery. On the right side the external and internal iliac veins join just beneath the junction of the corresponding arteries, and the common iliac vein so formed ascends, getting to the outer side of the corresponding artery; at the level of the intervertebral substance between the fourth and fifth lumbar vertebra, it is joined by the common iliac vein from the left side to form the ascending vena cava. All these points will be made clearer by the plan presented in Pl. XXXII, Fig. 7; 1, the aorta, dividing into 2, 3, the common iliacs, and these into 4, 4, the external, and 5, 5, the internal iliacs; 6, the ascending vena cava formed by 7, 7, the common iliac veins, and these by 8, 8, the external, and 9, 9, the internal iliac veins. About opposite the sacro-iliac symphysis, each iliac artery is crossed by the spermatic vessels and nerves; and a little higher up, by the ureter. Just before passing under Poupart's ligament, it gives off in an outward direction the circumflex iliac, and in an inward and upward direction the epigastric.

The anterior crural nerve comes into relation with the vessels, at their outer side, near the point where they emerge from the pelvis; it is not concerned in any of the operations for their ligation.

The lymphatic glands seen overlying the common iliac artery in Fig. 1, if enlarged, might give some little trouble in the isolation of the vessel.

(1) **Ligation of the abdominal aorta.**—This, beyond question the gravest of surgical operations, has now been done on the human subject six times, always for aneurism, and never

CHAPTER V.

OPERATIONS ON THE EXTERNAL GENITALS.

§ I. OPERATIONS ON THE PENIS.

(1) **Section of the frænum.**—It sometimes happens that the frænum is so short as to drag down the glans penis, and produce, in erection, a state somewhat resembling chordee. This may be either a congenital defect, or the result of cicatrization of an ulcer. In either case it may be remedied by putting the part on the stretch, transfixing it with a straight bistoury held as in Fig. 1, Pl. XXXIII, the flat of the blade toward the glans, and cutting forward so as to shave away the bridle.

Anæsthesia is hardly necessary in so trifling an operation; nor need the surgeon have any assistants.

(2) **Circumcision.**—This operation, which consists either in slitting up or in cutting away the redundant foreskin, may be rendered necessary in children by a congenital state of *phymosis*, producing symptoms analogous to those of stone in the bladder, or even, in the newly-born, preventing the flow of urine. In adults it may be required, when the retraction of the prepuce is interfered with by inflammatory swelling, so that remedies cannot be applied to chancroid sores between it and the glans.

Operation.—As this procedure, though not extensive, is very painful, it is better to administer an anæsthetic. When a child is to undergo it, an assistant may hold him on his knee, the pelvis well forward and the thighs depressed, so as to give the surgeon convenient access to the parts. There are several methods of operating. The one which I prefer in adults is shown in Fig. 2, Pl. XXXIII. A director is entered at the orifice of the prepuce, and pushed up along the back of the glans as far as the corona; its handle being now depressed, its point will start up, and along the groove a sharp straight bistoury may be pushed, so as to emerge through the skin, when

Fig. 1.

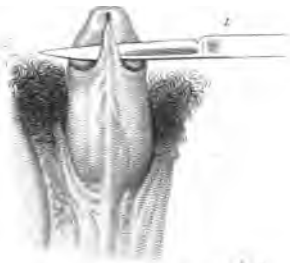


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

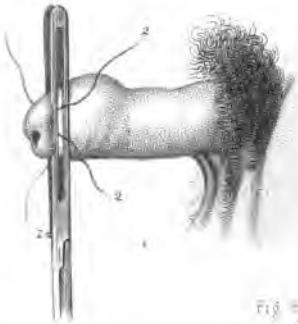


Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.



the division of the tissues over the director will be readily accomplished. When the object is merely to expose sores within the prepuce, this simple cut will usually suffice; and the healing will take place in due time with very little deformity. But in children it is better to go further, and complete the operation by paring off, as in Fig. 3, the flaps of redundant skin and mucous membrane. Three or four points of suture may be used to keep the edges of the skin and mucous membrane together properly; but this is not indispensable. A cold water dressing may be used for a few days, and then a mildly astringent ointment, such as Turner's cerate, or the ointment of the oxide of zinc, may be applied.

In cases of children, there is another plan which answers very well, viz.: to engage the prepuce, drawn forward, in the cleft handle of the grooved director, and then to shave it off close. This divides both the skin and mucous membrane, the edges of which may be stitched together as in the other method. The frænum must always be left intact.

Cloquet's method is shown in Fig. 4. It consists in introducing a grooved director under the prepuce, parallel to the frænum, on one side of it, as far as it will readily pass. (Care must of course be taken to avoid entering the urethra.) With a sharp-pointed, straight bistoury, run along the director, the tissues are now freely slit up; the same is done on the other side of the frænum, when the glans can be fully exposed. The edges of the skin and mucous membrane are now to be sutured together, and the dressing applied as after the last-mentioned process.

Ricord's plan of operating requires a special form of forceps, like ordinary dressing-forceps, but with long, straight, fenestrated blades. The prepuce is well drawn forward, and grasped in the forceps just in front of the glans; two sutures are next passed through the fenestræ, as in Fig. 5. An assistant now takes charge of the forceps, while the surgeon, putting the free portion of the prepuce on the stretch with a pair of rat-toothed forceps, in his left hand, shaves it off close with a sharp knife in his right (Fig. 6). The fenestrated forceps being now removed, the middle part of each suture is drawn up and cut, so as to leave one-half on either side through the skin and mucous membrane, as in Fig. 7. The operation is completed by tying the sutures, as in Fig. 8, and the wet dressing is applied.

(3) **Paraphimosis**, when the prepuce is retracted and cannot

be drawn down again over the glans, which by the constriction becomes engorged and swollen, has to be relieved by a procedure such as is shown in Fig. 9, Pl. XXXIII. The surgeon seeks with the thumbs to push back the glans, while with the fingers he grasps and draws forward the covering.

If this fails, the constricting fold of prepuce must be nicked with a bistoury or scalpel.

(4) **Amputation of the penis** may be rendered necessary by cancerous or epitheliomatous disease of the organ.

Operation.—This is very painful, and anæsthesia should be induced.

The patient should lie with his hips at the edge of an operating table, his knees wide apart, and his feet supported on chairs. The surgeon draws the skin lightly forward, grasps the penis with his left hand, and with a bistoury in his right slices it off; he then applies ice-water to the cut surface, and takes up all bleeding vessels with the ligature.

The most important errors to be avoided in this operation are, 1st, leaving too much skin, which will hang in folds about the stump, and 2d, allowing the urethral orifice to contract in healing. Only careful judgment can guide the surgeon in regard to the first of these. In order to avoid the second, several plans have been proposed. *Ricord's* is to slit up the urethra about a quarter of an inch, in four places—then turning the flaps so formed outward, to stitch them to the skin. *Teale* cuts the urethra across very obliquely, so as to make a long flap of its floor, which he turns back and stitches to the skin. *Miller* proposes a more complicated method, bringing the urethra and corpus spongiosum out through a button-hole cut in an inferior flap an inch and a half long, which flap is brought up to cover the cut end of the corpora cavernosa.

§ II. OPERATIONS ON THE SCROTUM.

(1) **Ligation of the spermatic artery** has sometimes been practised in order to bring about atrophy of tumors of the testis. It is readily done as follows:

Operation.—The part being shaved, the patient is etherized and laid on his back; the surgeon stands at the right side, and making the skin tense over the course of the cord with the fingers and thumb of his left hand, divides the skin and superfi-

Plate XXXIV.

Fig. 1.



Fig. 2.

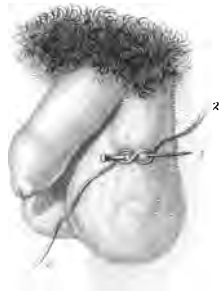


Fig. 3.



Fig. 6.

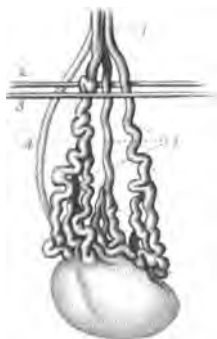


Fig. 4.

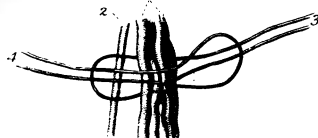


Fig. 5.



Fig. 8.



Fig. 7.



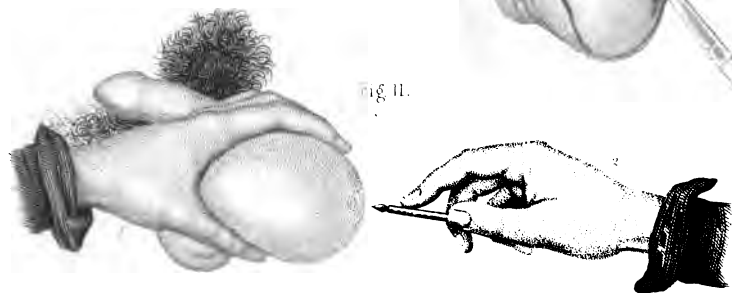
Fig. 9.

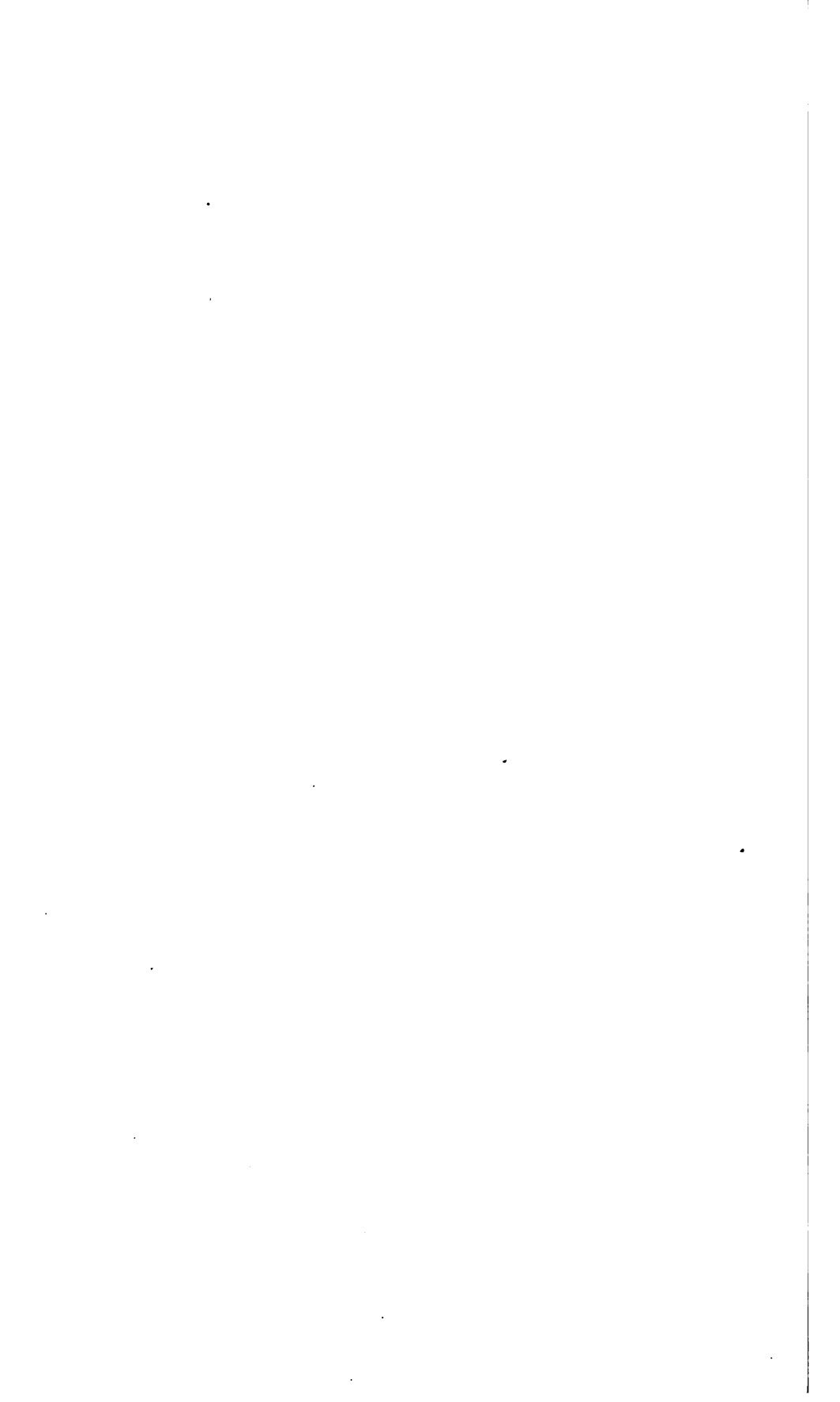


Fig. 10.



Fig. 11.





cial fascia to the extent of an inch and a half or two inches. Next he pinches up, nicks, and lays open the cremaster and the spermatic fascia, until the constituents of the cord are brought to view, when he isolates the artery and any small branches it may have, ties them all firmly at two points, say half an inch apart, and divides them between the two ligatures.

(The reason for putting a double ligature on is that it is necessary to guard against hemorrhage from the distal end of the vessel.)

(2) **Varicocele**, or dilatation of the spermatic veins, is sometimes treated successfully by producing closure of those vessels. This may be done in various ways.

Operation.—Fig. 2, Pl. XXXIV, shows a very simple method. The parts being shaved, the surgeon feels for the spermatic duct (known by its hard cord-like feel), and keeps it out of the way posteriorly, by pinching up the veins, which form a mass like a bundle of worms, in a fold of the skin in front. He then passes a harelip pin through this fold, behind the veins; and by putting a few figure-of-8 turns of a thread over the ends of the pin, he compresses the veins, with a small portion of skin. In about forty-eight hours the pin may be withdrawn, and the loops of thread left to fall off.

Another method is to include the veins subcutaneously between two loops of thread or wire. A double ligature is passed, as the pin was in the last described plan, *behind* the veins (Fig. 3, Pl. XXXIV). The skin alone being pinched up, another double ligature is passed, through the same orifices of entry and exit, but in the contrary direction, in *front* of the veins. The ends of each one are now passed through the loop of the other (Fig. 4), and drawn out firmly, when the veins will be compressed between the loops (Fig. 5), which will gradually cut their way through. The compression is maintained by tying the ends at either orifice around a bit of catheter or a small roll of lint; they may be tightened every twenty-four hours.

The method of Vidal (de Cassis) is shown in the three following figures of Pl. XXXIV. It consists in passing two silver wires, one, the thicker, behind the veins, the other in front of them (Fig. 6). They pass through the same orifices of entry and exit, as in the last case, and include as nearly as possible nothing but the veins.

Upon twisting the wires on one another, as in Fig. 7, an effect

on the veins will be produced as in Fig. 8; that is, the veins will be rolled up around the stronger of the two wires, and of course occluded. But little difficulty will be met with, in the course of forty-eight hours or so, in drawing out, first the thicker wire and then the other one—and by that time the veins will probably have become permanently closed.

Breschet's method, by means of two pair of blades to grasp the veins, some skin being also involved, may be readily understood by reference to Fig. 9. I do not know that it is at present used or recommended by any surgical writer.

(3) **Castration.**—The operation of castration, or removal of the testicle, is usually rendered necessary by tumors of that organ. (It has been recommended for the cure of epilepsy, but the idea has been most justly abandoned.)

Operation.—As this procedure is extremely painful, anaesthesia is always induced. The parts are shaved, and the patient is laid on his back, close to the edge of the table, his lower limbs either raised in the lithotomy position or supported on two chairs. The surgeon stands or sits directly in front, and grasps the affected part with his left hand, so as to steady it and render the skin tense anteriorly. He now makes either one incision, if the tumor be not adherent to the skin, or if it be, two elliptical incisions so as to include all the superficial disease; this section should extend from a point close to the external abdominal ring to the lower part of the scrotum, and should divide the skin and superficial fascia. These should now be dissected away so as to expose the affected organ (Fig. 10, Pl. XXXIV). By carrying the dissection deeply enough above, the constituents of the cord may be laid bare, and the vessels secured either by ligation or by acupressure. Next, the cord being divided, the testicle may be dissected away from its posterior attachments. All the diseased tissues should be removed; but care should be taken not to injure the sound gland or its envelopes. Every vessel which springs should be secured, and the wound closed with sutures. If, as sometimes happens, pus forms in the cavity of the scrotum, it must be allowed to escape by an opening at the lower part of the wound, and prevented from accumulating by very gentle pressure.

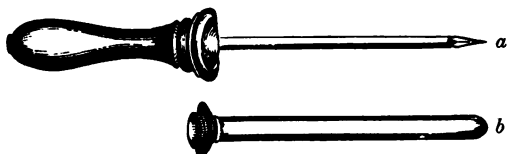
Hydrocele.—This affection, which consists in an accumulation of serum in the tunica vaginalis of the testis, may be treated in two ways: by the mere evacuation of the liquid, or by first

doing this, and then attempting to prevent its reaccumulation by causing the sides of the sac to adhere to each other. The former is called the palliative, the latter the radical cure.

Operation.—(a) The palliative operation, or tapping, is a very simple one. Anæsthesia can only be needful in very timid persons, and may in them be local.

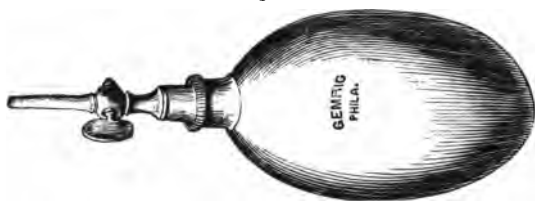
The patient sits on the very edge of a bed or chair, his knees wide apart. Sitting upon a lower seat directly in front of him, the surgeon grasps the distended scrotum with his left hand, so as to make the skin tense, and with his right pushes the point of the trocar and canula, Fig. 73, *a* (*b*, the cover to protect the

Fig. 73.



point of the trocar when not in use), into the cavity of the tunica vaginalis. In doing this the instrument is held, as in Fig. 11, quite firmly, at right angles to the surface of the skin, and the forefinger applied so as to limit the depth of the insertion. As soon as the point is felt to be free in the cavity, the handle is depressed so as to change the direction of the instrument, in order that the testicle may not be wounded. Upon the with-

Fig. 74.



drawal of the trocar, the liquid flows freely through the canula. Having emptied the sac, the surgeon withdraws the canula, and closes the little wound with a bit of plaster.

(b) If the operation is intended to accomplish a radical cure of the disease, the surgeon, after withdrawing the liquid from the cavity, injects through the canula a small quantity, f3ij or f3iij, of tincture of iodine. This is done by means of a gum-elastic bag, with a tube fitting into the canula (Fig. 74). He

then grasps and gently manipulates the scrotum on the affected side, in such a way as to bring the liquid in contact with the whole of the serous membrane.

It is necessary to use some judgment as to the amount of exercise the patient may be allowed to take for the two or three succeeding days—so as to induce a sufficient but not an excessive degree of inflammation in the sac.

An amount of swelling generally ensues, nearly or quite equal to that before the operation; this subsides, and adhesion occurs between the opposed serous surfaces.

In children, the mere drawing off of the liquid is very often followed by a permanent cure.

CHAPTER VI.

OPERATIONS ON THE URETHRA AND BLADDER.

§ I. INTRODUCTION OF INSTRUMENTS.

THE introduction of instruments along the urethra into the bladder, in the male subject, is an operation varying greatly in the degree of difficulty it presents. Sometimes, when the canal is unobstructed, it is so easy that a trained nurse, or even the patient himself, may learn to do it with safety; sometimes it is an operation requiring the utmost dexterity, patience, and judgment.

The simplest cases calling for this manœuvre are those where, as in low fevers, in paraplegia, or in old persons, the expulsive power of the bladder fails, and the urine must be drawn off. Again, when local applications are to be made to the interior of the bladder, where its cavity is to be explored for stone, or where a stone is to be crushed, the catheter, sound, or lithotrite usually passes with no great difficulty.

The more trying cases to the surgeon are: strictures, whether of venereal or traumatic origin; obstructions from enlargement of the prostate gland; and ruptures of the urethra.

Only general rules can be given here. The surgeon cannot be too well acquainted with the anatomy of the urethra and bladder; and yet he should, in passing an instrument, allow it to find its own way, and not attempt to force it in according to the route he thinks it ought to take.

In selecting an instrument for any case, regard must be had to material, size, and shape. Some high authorities prefer those known as gum-catheters or bougies; others employ metallic instruments, and my own experience is in favor of the latter in most cases. Of other materials, waxed cloth, catgut, etc., it is unnecessary to speak, since the gum and metallic instruments are within the reach of all surgeons at the present day.

As to the size, the rule may be stated that the largest instru-

ment that will pass is the best. Fig. 75 represents the English gauge, which is generally employed by instrument makers in this

Fig. 75.



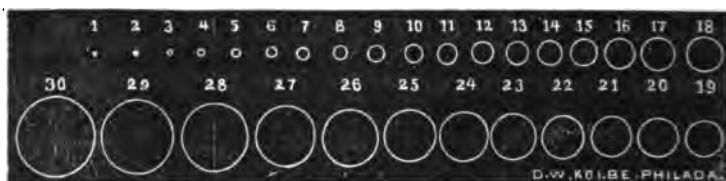
country, and by which instruments may be ordered. It is better for surgeons living away from the city to have a full set, with two or three of each of the medium sizes.

Fig. 76 represents the French gauge, numbered from 1 to 20, and Fig. 77 the German, from 1 to 30. It should be noted that the French No. 20 is smaller than the English No. 15.

Fig. 76.



Fig. 77.



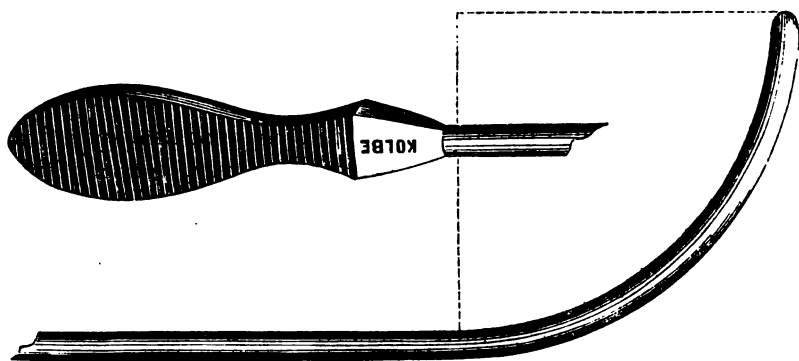
As to the shape of instruments, the curve and the point are the main features to be noticed. Metallic catheters cannot be altered in curve, while bougies, unless of steel, may be bent if desired. Gum-catheters often have to be stiffened by means of a strong wire or stylet, the curve of which can of course be altered.

According to Sir Henry Thompson, the best curve for catheters is an arc equal to about three-tenths of a circle of three inches and a quarter in diameter. In Fig. 78 this is represented, but not with perfect accuracy.

Bougies may be somewhat shorter, and sounds shorter still; moreover, the shape of sounds may vary with advantage, as will be mentioned in connection with the subject of stone in the bladder.

In every case, the extremity of the instrument ought to be most accurately rounded, and no edge or roughness left which can irritate or wound the mucous membrane.

Fig. 78.



It is possible, and some surgeons prefer, to pass instruments into the bladder with the patient standing or sitting; but the most favorable position in which to have him is on his back, his head and shoulders somewhat raised, his knees flexed, raised, and apart, so as to relax his muscles completely. The surgeon stands on the patient's left side, and raises the penis between the middle and the two last fingers of the left hand, the thumb and forefinger retracting the prepuce if necessary. Holding the instrument, warmed and dipped in oil, lard, cold cream or any other bland lubricant (castor oil is perhaps the best), in his right hand, he inserts its extremity between the lips of the urethral orifice, and allows it to follow the course of the canal. In stout persons it is often necessary to keep the handle of the instrument, at first, over the left groin; gradually bringing it over toward the median line as the tip advances along the canal. Often the tip will catch in the large follicle or lacuna which is apt to exist on the upper wall of the urethra within the glans; but it is easily disengaged, and by a slight rocking motion carried past this point. The force used should be in exact proportion to the resistance met with. A normal urethra, especially if the operation has been previously performed, will as it were swallow the catheter. If, as is often the case in old men, the prostate gland is enlarged, the handle of the instrument must be depressed so as to allow the tip to ride over the elevation and enter the bladder. Some-

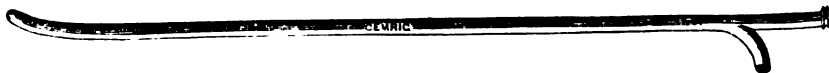
times it is even necessary to use an instrument with a shorter curve, in order to accomplish this manœuvre.

The success of the operation is announced to the surgeon by three circumstances. In the first place, any resistance that may have been felt ceases, the instrument slipping forward a little of itself, while its handle may be readily depressed. Secondly, the vesical end may be moved in any direction by rotating the handle. Thirdly, in catheterization, urine escapes in greater or less quantity.

Should resistance be met with at any stage of this operation, the surgeon simply pushes steadily, with very gentle force, against the obstruction; sometimes a few moments' perseverance will be rewarded with success. When this does not occur, a smaller instrument may be tried in the same way. A large instrument, however, will often answer better than a small one, and is certainly safer in inexperienced hands.

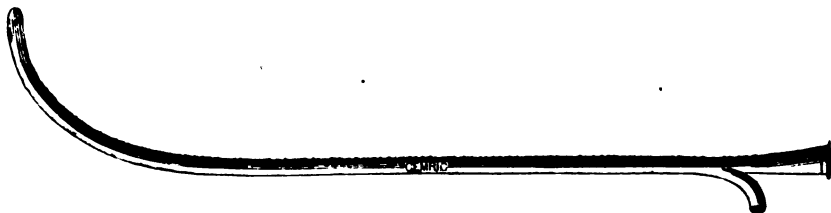
To wash out the bladder, we may use an instrument such as is shown in Figs. 79 and 80. This is merely a double tube, a

Fig. 79.



partition running its whole length from the bifurcation to the extremity; any liquid injected into it while it is in the blad-

Fig. 80.



der passing into the viscus by the upper eye or orifice, and then being forced out by the lower one along the other barrel, so as to flow away. By means of a syphon, a continuous stream can be made to pass through the organ, with any desired degree of force. Tepid water or mucilage, anodyne, astringent or otherwise medicated washes may be so used.

§ II. OPERATIONS FOR STRICTURE OF THE URETHRA.

Gradual dilatation.—When the narrowing of the urethra is not very great, nor of long duration, it may sometimes be overcome by the frequent introduction of bougies of larger and larger size, until the water is readily passed in a full stream. After this the patient must be taught to pass a large bougie for himself, and instructed to do so daily for a month, then twice a week for two months, then once a week for six months; reporting to the surgeon from time to time.

Another plan, available when the patient has the means and leisure for it, is to keep him at absolute rest for two or three weeks or longer, with a gum-catheter, of the largest size that can be easily borne, constantly in the bladder. Upon full dilatation being thus accomplished, the recurrence of the difficulty is prevented by the same means as above mentioned,—the frequent and systematic introduction of a large bougie.

(Operations for forcible or immediate dilatation will be presently described.)

Perhaps it will not be too much of a digression to remark here, that the surgeon is often called to cases of retention from stricture, which will be completely relieved by the administration of a warm bath, with full doses of opium by the mouth or rectum, or both. In these cases, though there may be a permanent narrowing of the canal, the immediate urgency of the symptoms is due to spasmodic contraction of the involuntary muscular fibres of the wall of the urethra.

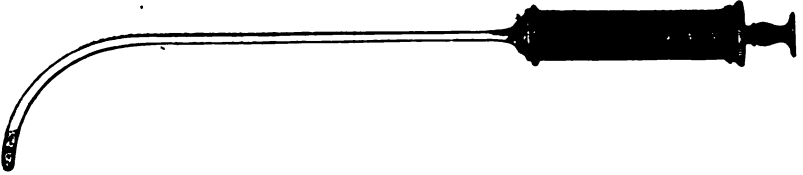
Should these means fail, it becomes necessary to pass an instrument, or in some way to draw off the accumulated urine. The surgeon first attempts to pass a catheter of medium size, and if he does not succeed, tries the smaller sizes in succession. And here, especially in the use of metallic instruments, much skill and care are required. Sir Henry Thompson recommends a bulbous-ended gum-catheter.

An excellent adjuvant to this process is the previous injection, by means of a urethral syringe, Fig. 81, of a few drachms of olive oil.

If the stricture cannot be thus overcome, it was formerly advised to puncture the bladder either above the pubis, or by the rectum. Both of these operations, however, are at the present day abandoned, since they afford but a temporary advantage, and are not devoid of risk.

Section of the urethra at the seat of stricture is far preferable. Unless the case is one of great urgency, and the retention must

Fig. 81.



be relieved without delay, the patient should be kept for a day or two at least, previous to any operation of this kind, and longer if possible, at absolute rest. He should take a warm hip-bath every night, followed by a suppository of a grain of watery extract of opium and half a grain of extract of belladonna. Through the day, diluent drinks should be freely used, and ten drops of the muriated tincture of iron should be given thrice daily, with five grains of quinine at bedtime. The day before the operation, a dose of oil should be given, followed next morning by an enema of flaxseed tea. These precautions, which I have myself found of great advantage, are recommended by Dr. Gouley, of New York, in an article to be presently quoted. He also advises the giving of ten grains of quinine with a quarter of a grain of morphia just after the operation.

External section of the urethra.—This plan has been especially advocated of late years by Syme; its value in very many cases is unquestionable. It consists simply in laying the strictured portion of the urethra freely open, by cutting down upon it through the perineum.

The process of so doing may be varied to advantage in different cases, but not in important particulars.

Operation.—Anæsthesia is always to be induced. The instruments required are: metallic bougies, a director or two, a scalpel, straight bistouries, sharp- and probe-pointed; sponges, and a double-curved silver catheter to leave in the bladder, should also be at hand. Syme uses a staff, such as is shown in Fig. 82, having its terminal portion grooved, and much narrower than the shaft, which offers a very well marked shoulder. This instrument has lately been modified to advantage by making the narrow portion very much shorter, so that it is far less apt to do mischief.

The patient, being thoroughly etherized, is brought to the edge of the operating-table, his knees raised and held apart by

Fig. 82.



assistants, so as to completely expose the perineum. The grooved bougie of Syme being now introduced and engaged in the stricture, the surgeon, sitting directly in front of the perineum, makes an incision about an inch and a half long in the median line, and divides all the tissues, cutting down upon the staff, until he opens the urethra. Now, entering the tip of the knife in the groove (he is perhaps safer if he exchanges the sharp- for a probe-pointed knife), he divides freely the strictured portion, so that the full-sized part of the bougie passes it readily. Usually, there is very little bleeding from the incision, and what there is, is readily checked by sponging with cold water. A double-curved silver catheter (Fig. 83) is introduced into the

Fig. 83.



bladder, and fastened there for two or three days; or, which is better, this is dispensed with, and a full-sized metallic bougie is passed every second or third day until the wound has healed.

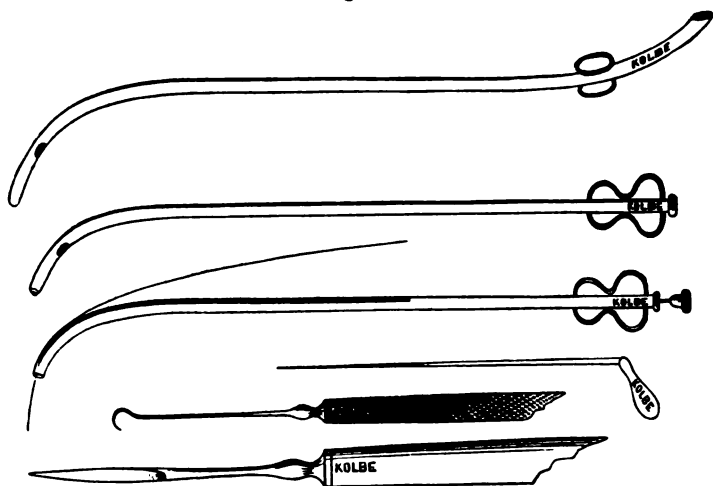
Prof. Gouley, of New York, has recently published* an account of a modification of this operation, which seems to possess some advantages.

The precise seat of the stricture having been ascertained by means of a bulbous-ended flexible bougie, the urethra is filled with olive-oil by injection. Next, a "capillary probe-pointed

* New York Medical Journal, Aug. 1869.

whalebone bougie" is introduced, and carried as far as possible, gently disengaging it if it becomes entangled in a lacuna. If it is actually arrested, perhaps in a false passage, it is held steady with the left hand, while with the right a similar one is passed alongside of it. Sometimes five or six guides are thus caught before the false passage is filled up and the natural route opened. When at last one is found to have entered the bladder,—which may be known by the ease with which it can be moved in or out,—the other guides are withdrawn. "The next step is to introduce a No. 8 grooved metallic catheter, with a

Fig. 84.

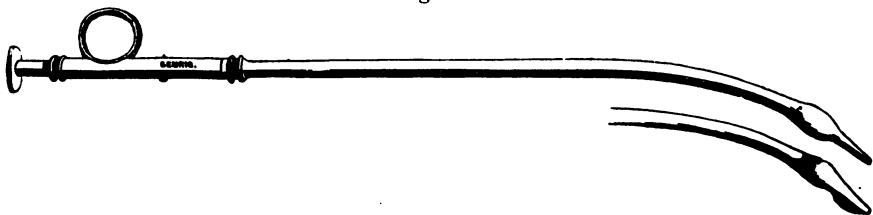


quarter of an inch of its extremity bridged over so as to convert the groove into a canal, the bridged portion itself being also grooved. Its introduction is accomplished by passing through the canal the free end of the retained guide, then holding the latter steadily between the thumb and index-finger of the left hand, and pushing the catheter-staff gently into the urethra, until its point comes in contact with the face of the stricture. The staff and guide are then kept in position by an assistant, who at the same time supports the scrotum. The patient is placed in the lithotomy position." The surgeon now examines the urethra *per rectum*, and then makes a free incision in the median line of the perineum. By successive cuts he now enters the groove of the instrument, first felt with the left forefinger-nail.

A silk suture is now passed through both lips of the wound in the urethra, drawn forward with the hook, Fig. 84, and cut in the middle. Each portion thus forms a loop, by means of which the assistants on each side can draw the lips of the urethral wound apart. The catheter is now withdrawn a little, and the guide being brought into view, a very narrow, beaked straight bistoury is passed in alongside of it, and the stricture divided, with about half an inch of the canal behind it. Finally, the catheter-staff is passed along the guide into the bladder; should it be arrested, the knife is reintroduced, and the incision extended backward. By the free flow of urine through the catheter, the surgeon is certain that he has fairly entered the bladder, and that he has not simply enlarged a false passage.

Internal section of the urethra.—This operation is done by inserting into the canal an instrument having a bulbous end, which conceals a blade; on reaching the stricture, this blade is unsheathed, and the contracted portion incised. Fig. 85 shows

Fig. 85.



the form of this instrument known as Gross's. It is sometimes made straight, as in Fig. 86. With this the cutting is done

Fig. 86.



from before backward, the blade being protruded, and then the instrument forced onward through the strictured passage. By other surgeons it is thought better first to clear the narrowed part, and then to divide it by withdrawing the instrument with its cutting edge in position.

Whichever of these plans is adopted, it is necessary to introduce an instrument very frequently afterward, so as in the

first place to effect full dilatation, and in the second place to prevent the channel from again becoming narrowed,—a result very apt to be unavoidable, even with the utmost care. On account, indeed, of the frequency with which relapse occurs after the internal division of stricture, this plan has been in great measure superseded by the one before mentioned, or by that to be presently described.

Urinary abscess.—When a stricture becomes, from an access of inflammation or from any other cause, impermeable to the urine, the gravest consequences may follow. The simplest natural solution of the difficulty is, the rupture of the urethra, and the formation of an abscess, which by opening externally gives rise to a perineal or urinary fistula.

But the surgeon should forestall even this, if called early enough, by passing a plain metallic bougie down as far as the stricture; putting the patient in position as before described, and then cautiously cutting in the median line of the perineum, until a gush of urine announces that the urgent peril is removed. After this he may either endeavor at once to carry an instrument on into the bladder, or, which in my opinion is better, he may let the parts rest until all irritation has subsided, and then institute whatever operation seems indicated for the permanent relief of the stricture, by section or dilatation. I have several times done this with the best results. The operation-wound, if properly treated, does not become a fistula.

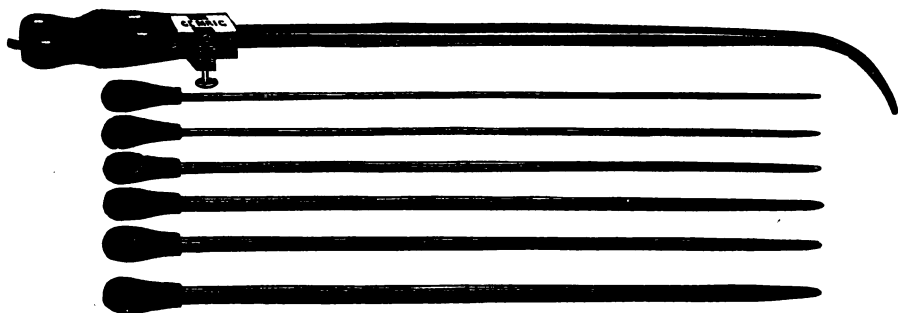
Rupture of the urethra.—This very severe injury, caused by kicks or blows on the perineum, by a fall astride of a board, or by some like accident, necessarily involves extravasation of urine, and the gravest dangers.

Unless the surgeon is fortunate enough to succeed in getting a catheter safely into the bladder, and fixing it there, external perineal section should be promptly performed. My own opinion is that, in every case of undoubted rupture of the urethra, it would be safer to do the operation. For if it is not done, we may at any time within the first ten or twelve days find symptoms either of perineal abscess, or, what is worse, of urinary infiltration, beginning to manifest themselves. And the prevention of these grave symptoms by early incision of the perineum is so much easier and more effectual than their cure by the same measure at a later stage, that it would seem hardly necessary to insist upon the former course.

The operation should be done as in the case of urinary abscess, unless the skin is already cut or lacerated, in which case it may perhaps be better to gain access to the urethra through the accidental wound, instead of making a new incision in the median line.

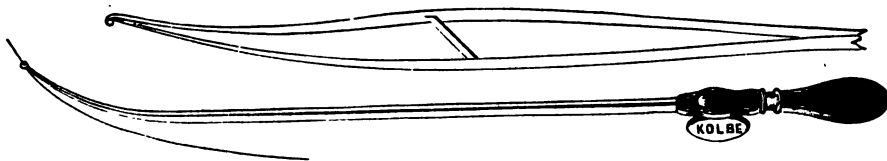
Forcible or immediate dilatation, or bursting.—This method of treating urethral stricture, originally proposed I believe by Perré, has been lately brought into notice again, chiefly by Mr. Holt of London. It consists essentially in introducing into the grasp of the stricture an instrument consisting of two apposed semicylindrical plates, between which is then driven a third, forcing them asunder, and dilating the narrowed portion of the canal. By using “plungers” of different sizes, the degree of distention is of course regulated. Fig. 87 shows

Fig. 87.



Mr. Holt's dilator, with six different sizes of plungers. Another form of dilator, the one used by Sir Henry Thompson, of London, is shown in Fig. 88, with a fine whalebone guide, added by Dr. Maury of this city. The advocates of this plan of treat-

Fig. 88.



ment, which has been satisfactorily tested in Philadelphia by quite a number of surgeons, claim for it safety, ease, and permanent good results. I have seen it used, but have never myself

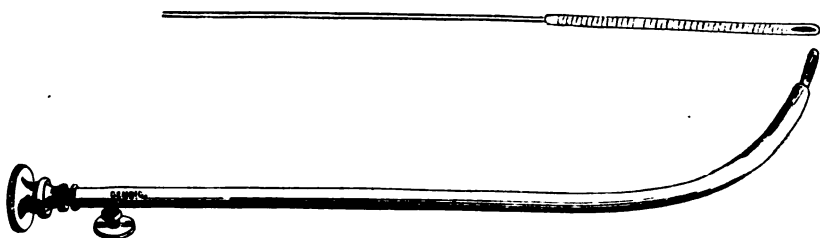
employed it, and can therefore only speak on the authority of others as to the effects obtained.

There are other forms of dilators, chiefly on the plan of the separation of two blades by means of a screw, but they are not so efficient as those above mentioned, and no safer; so that it seems hardly necessary to describe them.

Cauterization.—This has been recommended for the cure of stricture, but has failed to maintain its place, except perhaps in very slightly-marked cases. It is, however, a valuable plan of treatment for long-standing gleet, or for prostatic irritability.

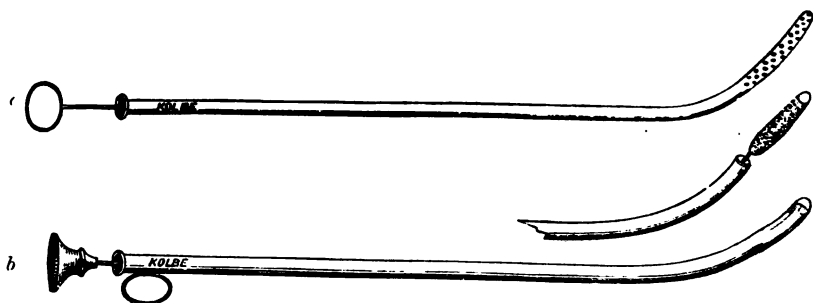
In Fig. 89 is represented Lallemand's porte-caustique, which

Fig. 89.



has never been superseded by anything better. The little cup at the end of the stem shown separately in Fig. 89, being filled with solid nitrate of silver, by heating it and then applying to it the end of a stick of that substance, is put into the catheter-like stem, to be protruded as in the lower figure when the part of the urethra is reached to which the application is to be made.

Fig. 90.



Another form of the instrument, that of Dr. D. H. Agnew, of this city, is represented in Fig. 90. The inner stem carries at its extremity a small cylinder, around which is wrapped a thread,

to be dipped in as strong a solution of the nitrate of silver as it may be deemed desirable to use in any case. The method of using this instrument does not differ from that described for Lallemand's.

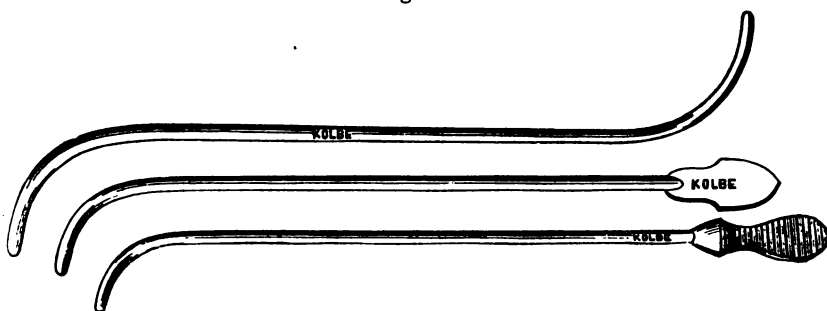
Fig. 90, *a*, shows another form of instrument; it is introduced into the urethra, and then, the saturated plug being pushed down to the perforated extremity, the medicated liquid escapes through the orifices, and comes in contact with the part to be influenced.

§ III. OPERATIONS FOR STONE IN THE BLADDER.

Sounding for stone.—This includes not only the detection of the presence of a calculus, but the appreciation, more or less accurate, of its size, character, and position.

In Fig. 91, the upper instrument represented is the ordinary metallic bougie; the two lower are sounds. The latter are seen to be shorter and slightly more curved than the bougie.

Fig. 91.



The rational symptoms of stone being made out, the patient is directed to remain at entire rest for at least twelve hours, and to hold his water for about two hours before the sounding is done. The instrument is passed like a catheter, and its short beak drawn backward and forward, and rotated either way, always with the utmost gentleness, until the whole bladder has been explored. Anæsthesia will be necessary if the urethra or bladder be very irritable; sometimes the stone cannot be felt without it. By the feel of the stone its character as to hardness or softness may be judged of. By the length of contact of the sound, some idea of its size may be gained, while its mobility

or fixedness may be more or less accurately detected. Sometimes the left forefinger in the rectum gives us valuable information in connection with sounding.

Notwithstanding the advocacy by some authors of sounding with the lithotrite, or with catheter-sounds by which the bladder may be injected, the solid steel instrument will probably never be superseded for the purpose.

There are two methods by which calculi may be removed from the bladder: lithotomy, or cutting, and lithotrity, or crushing. With the wide subject of the history of these operations, it is not possible to deal here. As to the choice between them, it may be said that the former is almost always to be preferred in children, and as a general thing in the very old. Lithotrity answers best in cases of adults, where the stone is small and soft, the genito-urinary organs not specially irritable, and the urethra of full calibre.

It is an invariable rule, in all operations for stone, of whatever kind, that the rectum should be empty; but surgeons generally prefer to have some liquid in the bladder. Preparation by tonics and generous diet will add to the chances of success, whenever the disease has existed for a length of time and caused emaciation and debility.

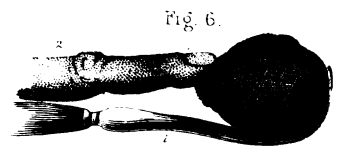
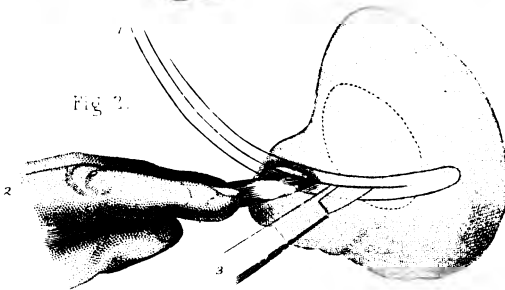
Another valuable precaution is to keep the patient at complete rest for a day or two before he is operated on.

Lithotomy.—There are four methods of cutting for stone: (1) the ordinary lateral; (2) the bilateral; (3) the median; (4) the suprapubic or high operation. Whichever of these is chosen, the rule is imperative that the calculus should be felt in the bladder, *at the time*, or the operation postponed.

Surgical Anatomy.—The anus is nearly at the central point of the perineum, when the patient is placed in what is known as “the lithotomy position.” An inch and a half or more in front of it is the bulb of the urethra, and just behind this, in the median line, but deeper, is the membranous portion of the canal. The membranous portion, traced backward, ends at the prostate gland, through which the canal runs, this part of it being called the prostatic portion.

The transverse perineal muscle runs across from near the tuber ischii to the raphé, a little in front of the edge of the sphincter ani muscle. The superficial perineal, and transverse perineal arteries, lie upon the surface of the transverse muscle. The artery of the bulb arises from the pudic, and runs across and forward to the bulb.

On deeper dissection we find the levator ani muscle, which forms the floor of



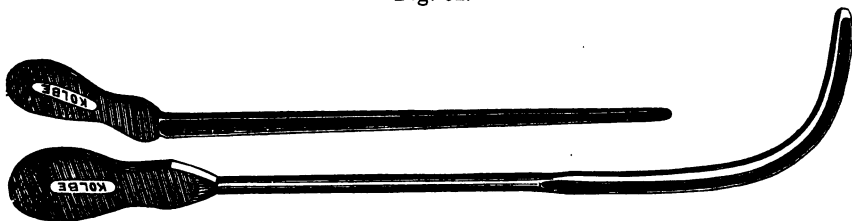
the pelvis, and is inserted into the sphincter ani and raphé of the perineum, surrounding by its anterior fibres the membranous portion of the urethra.

One layer of the deep perineal fascia runs up to the bulb, another to the anterior edge of the prostate, so that the membranous portion of the urethra lies at the bottom of the space between the two. Cowper's glands lie at either side of this space.

Operation.—1. Position of the patient. Ether having been administered, the buttocks are brought to the edge of the operating-table, the legs flexed on the thighs, and the thighs on the pelvis. Each foot is then placed in the palm of the corresponding hand, and firmly bound there with turns of a roller. This is called "the lithotomy position." (Pl. XXXV, Fig. 1.)

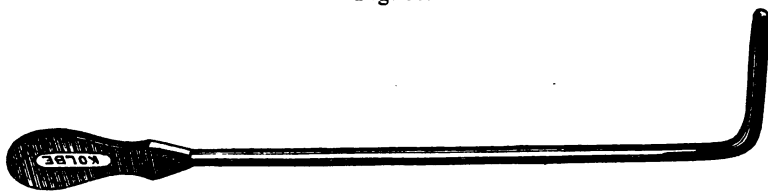
2. Instruments required. For the sound previously used to detect the stone (see *Catheterization*) is now substituted the staff (Fig. 92), an instrument with a longer curve than the bougie or

Fig. 92.



catheter, and with a deep and wide groove at its convexity, (or a little to the right of this, as in Fig. 92), so as to guide the knife into the bladder. Besides this, a good-sized scalpel or two, one probe-pointed, forceps of various shapes, scoops, and a large syringe for washing out the bladder, are needful. A rectangular

Fig. 93.

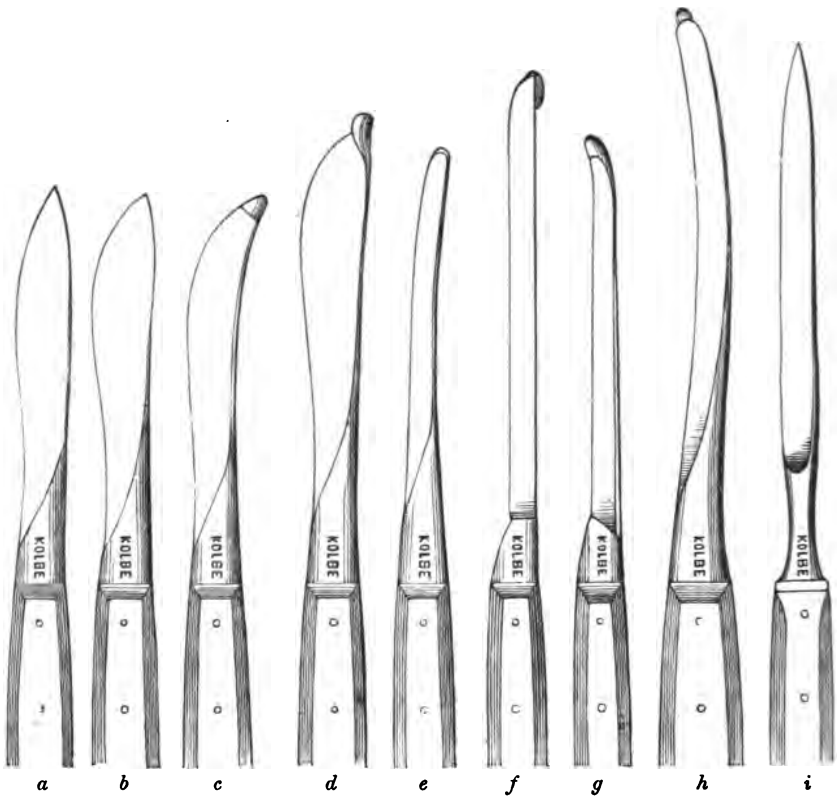


staff (Fig. 93) has been devised by Prof. Buchanan, of Glasgow; but it has never come into general use.

Various shaped knives have been employed and recom-

mended by different surgeons and writers on lithotomy. By some, the same knife is used throughout; by others, the sharp-pointed scalpel is exchanged for a probe-pointed one as soon as the urethra is fairly opened. The principal forms of knives are shown in Fig. 94: *a*, Brodie's; *b*, Liston's; *c*, Erichsen's; *d*, Thompson's; *e*, Fergusson's; *f* and *g*, Blizard's; *h*, a slightly curved beaked knife, whose inventor's name I do not know.

Fig. 94.



At *i*, is represented the knife used by Dr. Gross, whose experience in this operation is perhaps second to that of no other surgeon in this country.

The gorget, Fig. 95, formerly used for making the section of the prostate, its beak being engaged in the groove of the staff, is now almost, if not altogether abandoned.

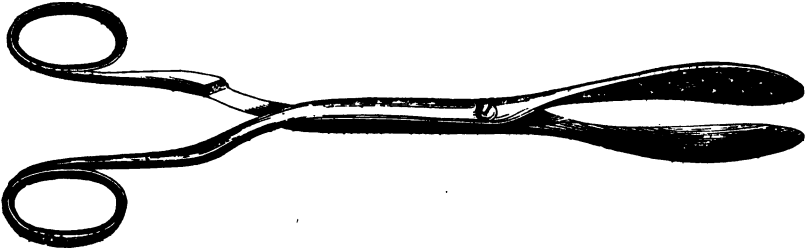
The forceps generally used are nearly of the pattern shown in

Fig. 96, the blades being very smooth on the outside, but studded interiorly with points to prevent their slipping when the stone is grasped.

Fig. 95.

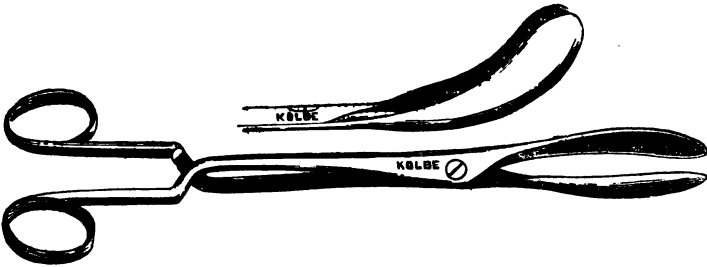


Fig. 96.



Besides these, we should have forceps with the blades curved, as in Fig. 97. It is well to have them of various lengths and sizes.

Fig. 97.



Forceps are also made with fenestrated blades, to occupy somewhat less room; but if the stone is rough, the portion exposed through the openings may lacerate the tissues at the margin of the wound in the process of extraction.

Fig. 98 shows the shape of the scoops, the object of which will be presently explained.

Fig. 98.



Sponges, tenacula, artery-forceps, ligatures, hot and cold water, etc., should also be at hand.

3. Assistants. Five at least; one to give the anæsthetic; one at each knee, to hold it well outward; one, the most important, to hold the staff; and one to hand the instruments and tie the vessels.

Everything being ready, and the perineum shaved, if necessary, the surgeon, standing in front of the patient, passes the staff, and feels the stone. The assistant who is to hold the staff, standing on the patient's left, grasps the handle of the instrument, and keeps it exactly as the surgeon directs, either hooked up against the pubis, or bearing prominently forward in the perineum; he at the same time, with his left hand, holds the genitals up and out of the way. Another assistant, standing in front of the last named, holds the left knee outward, while another does the same for the right.

The surgeon now makes his first incision, beginning in the median line, an inch and a half in front of the anus, and cutting downward and outward to a point midway between the anus and the left tuber ischii; this incision divides the skin and superficial fascia only. The fascia and muscular tissues are next cut, toward the staff, deepening the first wound in front. With the knife and left forefinger this process is continued, until the nail can be engaged in the groove of the staff. Now, guiding the same or a probe-pointed knife on the finger, the tip of the knife is engaged in the groove, and pushed on along it, the handle of the knife being depressed (Pl. XXXV, Fig. 2), until the fact of the bladder being entered is announced by a gush of urine. At once the knife is withdrawn, and the finger pushed along the staff into the bladder, so as if possible to feel the stone. In doing this, the cut in the prostate gland is dilated, and may be more widely opened by a seesaw movement if the stone is very large. As soon as the finger is fairly in contact with the stone, the staff may be withdrawn; and the surgeon, passing in a pair of lithotomy forceps, closed, tries to grasp the stone between their blades. If he succeeds in so doing, he at once attempts to withdraw it with them, gently rocking them if the stone is too large to come easily through the opening. Sometimes an oval stone is caught with its long axis across the forceps, in which case the grasp must be changed, with the aid of the forefinger.

Occasionally a strong pair of forceps (Fig. 99) must be introduced, and the stone broken up, so as to be removed piecemeal.

Sometimes a scoop (Fig. 98) has to be employed, the stone

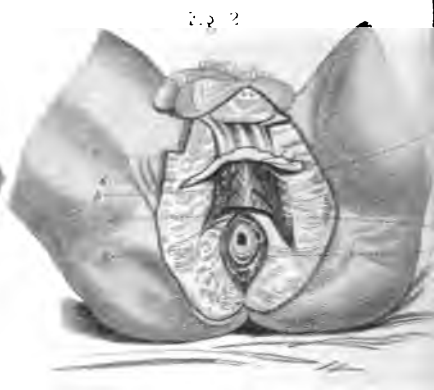
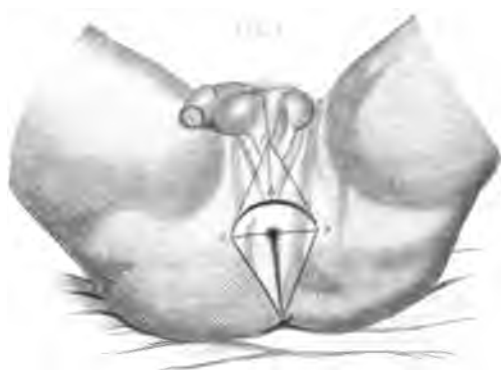
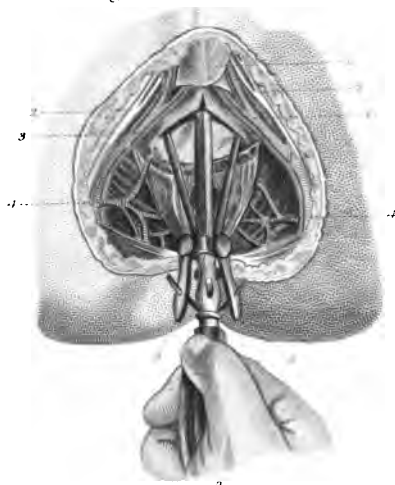


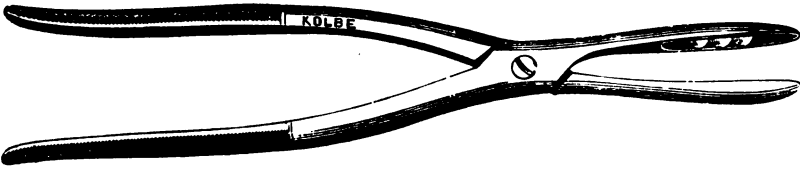
Fig. 4

Fig. 5



being caught between this and the forefinger, as in Fig. 6, Pl. XXXV.

Fig. 99.



All the larger portions having been taken away, a stream of tepid water should be driven into the bladder from the syringe, until no more fragments or débris are washed out by it; and then the cavity should be cautiously but thoroughly explored with the finger, to detect any encysted or otherwise engaged calculi.

Hemorrhage, if there is any, should now be arrested by ligating the vessels which bleed. The hands and feet are untied, the knees fastened together with a handkerchief or two or three turns of a roller, and the patient placed in bed.

Should blood continue to ooze, a bit of ice may be placed for a moment or two in the wound; and if this fails to arrest it, pressure may be made by means of the metallic tube shown in

Fig. 100.



Fig. 100, a mesh of lint being tied around the constricted portion, which is passed into the wound, and secured in the bladder by tapes passing from the rings to a waistband. The urine flows freely away through this tube.

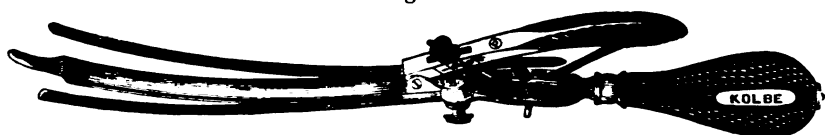
(2) The *bilateral* method. This differs from the procedure just described, in respect only to the line of incision and the method of making it.

Operation.—A semilunar external incision is made through the skin, from a point midway between the right tuber ischii and the anus, curving forward so as to cross the raphé about an inch and a quarter in front of the anus, and terminating at a point opposite to that of its commencement, *i.e.*, midway between the anus and the left tuber ischii (Figs. 1, 2, 3, Pl. XXXVI).

The tissues are next divided in successive layers, until the staff is felt, when the point of the knife is carried into its groove,

so as to make an opening in which the surgeon can enter the beak of the double lithotome caché, Fig. 101. (See also Fig. 4, Pl. XXXVI.) The extent to which the blades shall be opened

Fig. 101.



having been previously arranged by means of the small screw just back of the joint, this instrument is now engaged in the groove of the staff, pushed well on into the bladder, opened by pressing on the lever, and withdrawn, cutting its way out through the prostate. A gush of urine follows, and the finger is immediately introduced as in the lateral operation.

The remaining steps are accomplished in the manner before described.

(3) The *median* operation.

Operation.—An incision is made in the median line, from about half an inch above the anus, directly into the groove of the staff, along which a short cut, say half an inch long, is made in the urethral wall, and as the knife is drawn out, the skin is divided upward to the extent of about an inch and a half. A large director, such as that represented in the upper drawing in Fig. 92 (p. 129), is now introduced along the staff into the bladder, the groove of the director being kept downward like that of the staff; and the staff withdrawn; a probe-pointed knife is then guided in upon the director, the prostatic portion of the canal laid open to a sufficient extent, as in Pl. XXXV, Fig. 4, and the vesical cavity reached with the finger, when the forceps may be introduced and the extraction of the stone accomplished as in either of the before-mentioned methods.

(4) The *high* or *suprapubic* operation has very seldom been done, and the results attained have not been encouraging. It may, however, be the only resource, as for example where the ordinary "lithotomy position" cannot, from rheumatic or other stiffening of one or both hip-joints, be assumed by the patient; or where there has formerly been disease or injury of the perineum, altering the relations of the tissues.

Plate XXXV

Fig. 1



Fig. 2

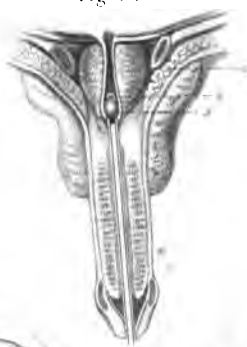


Fig. 3

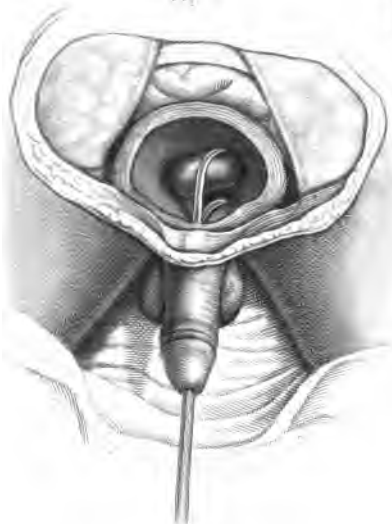


Fig. 4



Surgical Anatomy.—When the bladder is much distended, it rises above the pubes, and is separated from the surface only by the skin and superficial fascia, and a variable but not large amount of deeper fibrous tissue; the pouch of peritoneum usually existing in front of the fundus being obliterated.

Operation.—The pubic region being shaved, the patient is laid on his back on the operating-table, his nates close to the edge, and his legs hanging over. An incision is then commenced just over the symphysis, and carried upward in the median line for about three inches; the skin and superficial fascia only being divided. The linea alba is now cautiously opened for an inch or more. A long and strongly curved sound is now introduced through the urethra, and its point pushed, if possible, against the anterior wall of the bladder so as to press it forward into the wound. Cutting down upon this, the surgeon enters the bladder with a probe-pointed bistoury, and cautiously divides the anterior wall downward for the space of about an inch, still in the median line. He now introduces the finger, feels the stone, inserts the scoop or forceps, and effects the removal (Pl. XXXVII, Figs. 1, 2), enlarging the opening if necessary, but never dividing the peritoneum.

Another plan of opening the bladder is by means of a long canula and stylet introduced like the sound above mentioned, and its point pushed through the anterior wall from within.

After the removal of the stone, a gum-catheter is placed in the bladder so as to keep it empty, and the wound is closed with care, so as to prevent if possible urinary infiltration or the formation of abscesses.

Comparison of these operations.—Lithotomy having been decided upon, unless the stone is known to be very large, the lateral method is usually preferable; although for an experienced and confident operator, there is perhaps little to choose between this and the median.

The bilateral method gives a greater amount of space for the withdrawal of the stone, but has no other advantage; while in unskilled hands there is a chance of doing harm by too wide an incision of the prostate.

The danger of peritonitis and infiltration of urine after the high operation is so much greater than after either of the other procedures, that it should only be chosen when the stone is very large, the prostate much hypertrophied, or the "lithotomy position" impossible.

Lithotrity, or Crushing.—This operation, one of the modern improvements in surgery, is applicable to cases of adults, where the constitution is good, the urinary organs sound, the bladder not specially irritable, the urethra free from stricture, and the calculus single, of moderate size, and not too hard. Sometimes it does well in old people, and sometimes in cases where some of the above-mentioned conditions are wanting; but the general rule is as stated.

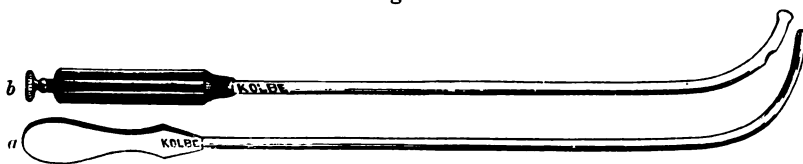
For a day or two beforehand, the patient should be kept at rest, and the bladder should, if irritable, be prepared by the daily passage of a good-sized sound for the manipulation it is to undergo.

Generally several successive "sittings," three or four days apart, are required to effect complete relief. Of these, the first may be two or three minutes in length, but not more; the later ones should not exceed three to five minutes. Anæsthesia is only required when the bladder is very sensitive.

The instruments needful are: steel sounds, catheters, and lithotrites. A syringe of about ʒviij capacity, fitted to the catheters, should be at hand also.

A somewhat short-beaked sound, Fig. 102, *a*, with a bulbous extremity, is the best; some operators use the lithotrite itself

Fig. 102.



for the purpose, finding and catching the stone at once. Some surgeons prefer a hollow or catheter-like sound, Fig. 102, *b*, by means of which the bladder may be injected if it is desired, without changing the instrument.

The lithotrite consists of a grooved steel bar, turned up for about an inch at the end, with a steel rod sliding in the groove, and likewise bent (Figs. 103, 104, 105).

By far the best arrangement is to have the two blades freely movable upon one another, but with a catch so that the shaft may be brought into connection with a screw; in this way the stone may be easily sought for, and when once it is grasped,

the screw may be brought into action, and the male blade driven home, crushing the stone against the female blade. The

Fig. 103.

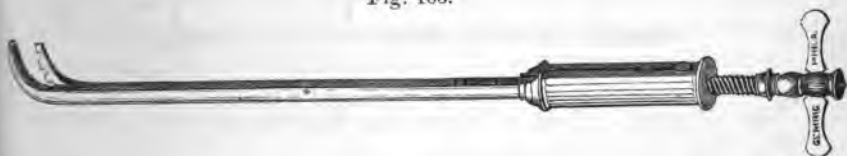
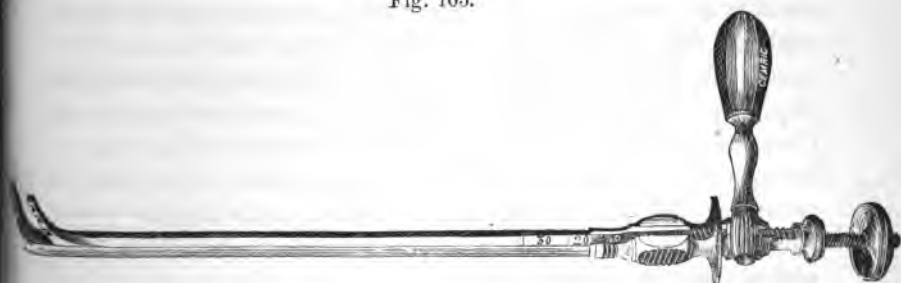


Fig. 104.



latter should have a hole at the bend, for the escape of *débris*. The screw may be worked directly with the thumb and fingers (Figs. 103, 104), or by means of a rack and pinion (Fig. 105).

Fig. 105.



A small lithotrite to break up fragments lodged in the urethra is sometimes useful, or they may be caught by means of the

Fig. 106.



small scoop with a hinge-point (Civiale's), Fig. 106, and thus drawn out.

Pl. XXXVII, Fig 5; 1, the scoop; 2, its end, hooked around 3, the stone; 4, the prostate gland.

Fig. 107, p. 138, shows a delicate pair of urethral forceps for the same purpose.

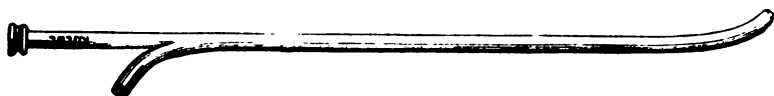
It is not necessary, although a common practice with some surgeons, to wash out the bladder with tepid water at the

Fig. 107.



close of each sitting. When this is done, a double catheter, Fig. 108, will be found useful.

Fig. 108.



Operation.—The patient, having retained his water for two or three hours, is laid on his back, on a firm mattress at a suitable height; the surgeon stands on the right side, with his face toward the foot of the bed, and takes the penis between the middle and ring-fingers of his left hand, opening the meatus with the thumb and finger. With his right hand he now gently enters the lithotrite, closed and well oiled, into the canal, and slips it gradually down, keeping the handle at first over the right iliac spine, then sweeping it around into the median line, and bringing the shaft perpendicular, until the point nears the prostate; the handle is now depressed, to a degree proportioned to the enlargement of the prostate, over which the tip glides into the bladder.

Once fairly in, by a rotary movement of the handle, the beak of the instrument is made to fall over laterally, when, if the stone is touched, the male blade is withdrawn a little, so as to try to grasp the stone between it and the female blade. (Pl. XXXVII, Fig. 3.) If this be accomplished, the instrument is turned back again so as to bring the stone into the middle of the vesical cavity (Pl. XXXVII, Fig. 4), and the male blade is screwed home. This manœuvre is repeated again and again, until the time for the sitting is exhausted.

If at the first attempt the stone is not felt, the beak may be rotated so as to fall over to the other side of the median line, and if this fail, a gentle backward and forward motion may be made, still with the lateral half-turns, so as to explore thoroughly the bas-fond of the organ.

It must never be forgotten that the male blade is the one to be moved on the female; that the crushing is to be done in the middle of the cavity; and that in effecting it the blades must always be brought into contact. Fragments cannot be safely drawn through the urethra in the grasp of the instrument, although I have several times seen this done with undeserved success.

The instrument should be very lightly held in searching, very firmly and steadily in crushing.

When symptoms of inflammation of the bladder or testicles arise after an operation of this kind, prompt treatment is necessary. No further attempt at crushing the stone ought to be made until they have been wholly subdued, and then only with great caution.

Stone in the female bladder is of very rare occurrence. When it is met with, if the concretion is of small size, it may often be removed by merely dilating the urethra (by expanding a pair of forceps introduced through it) so as to afford room for its passage or extraction; or an incision may be made upon the straight staff or director shown in Fig. 92, p. 129, and the forceps passed into the bladder as in the male subject.

CHAPTER VII.

OPERATIONS ON THE ANUS.

§ I. HEMORRHOIDS.

Hemorrhoids, or Piles, when entirely external to the sphincter ani, may be clipped away with scissors, or shaved off with a knife, the tumors being in either case drawn out with a pair of forceps, or by means of a ligature passed through them. (Pl. XXXVIII, Figs. 1, 2.)

Anæsthesia should always be induced; if it is contraindicated, the operation can hardly be necessary. Care should be taken not to cut away too much tissue, since this would involve a most troublesome narrowing of the anal orifice. The patient should lie on his left side, his left thigh and leg stretched out, his right drawn up into strong flexion, and his hips close to the edge of the bed or table. An assistant should draw up the right buttock so as more fully to expose the parts.

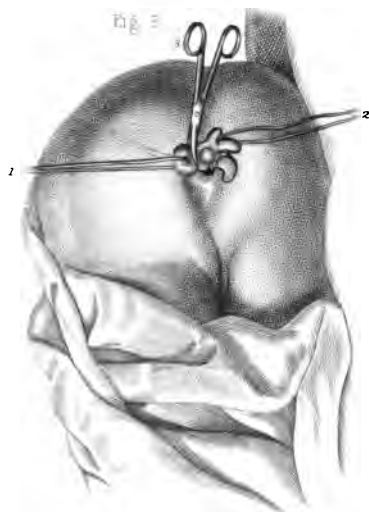
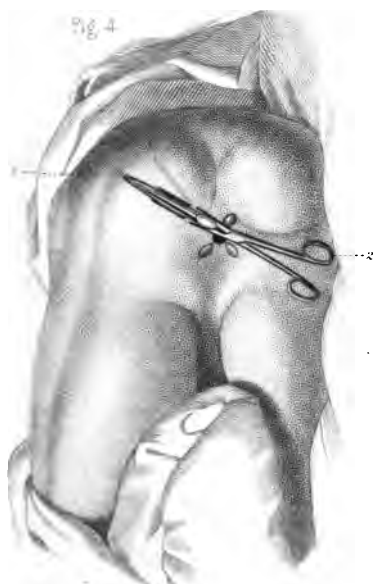
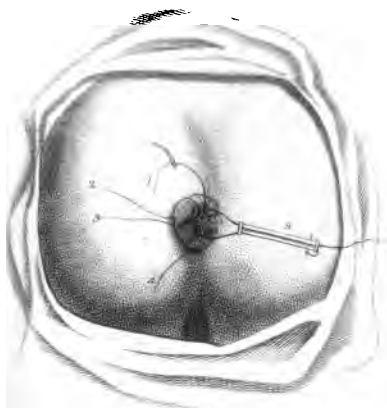
Should bleeding occur, it may be checked by ligating or twisting the bleeding vessel, by the application of styptics, by a stream of cold water from a syringe, or by pressure with dry lint.

Internal piles should never be excised, since death has resulted from uncontrollable bleeding after such operations, even in the hands of the ablest surgeons. Strangulation, by ligature or by the wire and double canula, is safer, and is always successful if thoroughly done. Other methods, such as the application of strong nitric acid, nitrate of silver, or even the actual cautery, have been used, but are



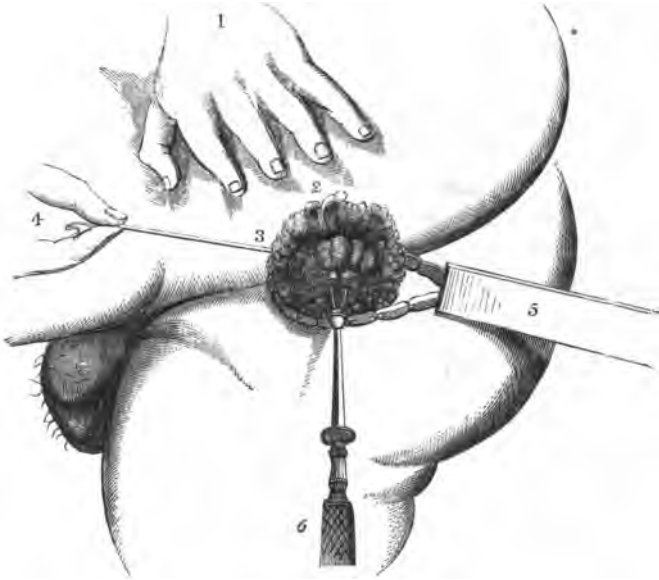
not more reliable. Nitric acid may be applied, as advised by Mr. Henry Smith, of London, by first enclosing the base of the pile closely with a metallic shield such as is shown in Fig. 109, to protect the neighboring surface; or the same object may be

Fig. 1.



attained by smearing the surface around the pile with olive-oil, or any other unctuous substance. The *écraseur* has found ad-

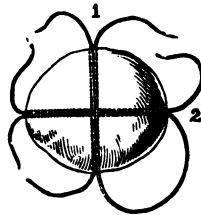
Fig. 110.



vocates, but is only a prompter means than the ligature; the mode of its application is shown in Fig. 110, the tumors having been first surrounded at their base with a ligature, so as to make a well-defined groove for the chain.

Operation of ligation.—The patient is first made to strain down while sitting over a vessel of steaming-hot water, so as to cause the tumors to protrude as completely as possible. He is then to be etherized, and as soon as the first insensibility is induced, a silk ligature is to be passed, by means of a needle, through the base of the hemorrhoid (Fig. 111); if the margin of the anus is fringed with the piles, a thread should be carried from within outward through the base of the principal one on each side. The long ends of each thread are knotted together and left hanging.

Fig. 111.



Full anæsthesia is now induced, and the patient laid in the same position as for the excision of external piles. The surgeon

draws down the tumors by means of the ligatures, and if they have narrow pedicles, proceeds at once to cast a strong thread around them, close to their bases; including as much as he can in each loop. But if the piles have a large surface of attachment, it is better to push a strong needle through their bases, at right angles to the threads, and then, dividing the loops, to tie the corresponding ends as tightly as possible together, beneath the ends of the needle, which prevents the threads from slipping up so as to embrace too little of the tumors. Sometimes it is well to take a fresh thread and cast it around the whole mass, so as to ensure the strangulation. When the tumor becomes blue and cold, the needle may be withdrawn, and the parts left to slough away. Pain is to be allayed, if there is any, by lead-water and laudanum, by suppositories containing opium, or by the hypodermic injection of morphia.

When the wire and canula is chosen, the essentials of the operation are the same; the wire loop is adjusted around the base of the tumor, its ends passed through the barrels of the canula, drawn as tightly as possible, and fastened each to the ring or button on the side of the instrument.

In Fig. 1, Pl. XXXVIII, the ligature is seen passed through the mass of hemorrhoids on the left side of the anus, 1, 2, 3, 4, the wire loop and canula, 5, ready for adjustment over those on the right side.

When the piles are partly internal and partly external, the margin being covered on one side with skin and on the other with mucous membrane, the skin should be completely divided by touches with a knife, before the strangulation is made; otherwise the compression of the cutaneous nerves will give rise to very intense and long-continued pain. One mode of doing this is seen in Fig. 2, Pl. XXXVIII; the buttock being drawn upward by an assistant, while the tumor is drawn downward by means of a needle thrust through its base, so that the skin is put on the stretch, and the surgeon has a fair chance for its complete division. Here also the wire loop is seen adjusted, so that it can be tightened as soon as the parts are prepared for it.

Fig. 112 shows the apparatus devised many years ago by Dr. George Bushe, for passing the ligature around hemorrhoidal tumors; it is still in use, and often answers better than any other. It consists of a needle, *a*, curved, and with an eye near the point. This is threaded, and pushed through the base of the pile from

above downward, by means of the needle carrier, *b*, the tip of the needle being caught and pulled through with the forceps, *e*. In order to get at the tumor with greater facility, it is grasped and drawn downward with the forceps, *c*, which are either toothed, as in the cut, or furnished with expanded and fenestrated ends. A pair of scissors, *d*, curved on the flat, to be used to snip off external piles, are generally put in the cases as sold.

Fig. 112.



Before performing any operation for hemorrhoids, the surgeon should see that the patient's bowels are thoroughly cleared out by medicine, aided if necessary by an enema; and after the operation is completed, the entire rest of the parts should be secured by the administration of opium, and by a concentrated diet, so as to prevent the formation of fecal matter as much as possible. A certain degree of difficulty of micturition, amounting sometimes to actual strangury, is apt to occur for the first two or three days after the strangulation of piles; but the use of hot fomentations to the hypogastric region, and of suppositories containing opium, will usually allay this symptom.

These operations, when successful, give great relief, and are generally considered to be free from danger. I have, however, within a little more than a year, known of three cases in which fatal tetanus ensued upon the operation by ligature; one oc-

curred to myself in private practice, one in my wards at the Episcopal Hospital, and one in the service of one of my colleagues in that institution.

§ II. PROLAPSUS ANI.

Prolapsus of the rectum sometimes demands special operative interference, although it is generally met with as a secondary symptom, as for example in cases of piles or stone in the bladder.

The operation does not differ materially from that for external hemorrhoids; the great object being to remove, symmetrically, the exact amount of tissue which is superfluous. Ether having been administered, the patient is placed on his side, his limbs drawn well up, and the parts exposed. The surgeon now, with forceps, pinches up in succession several radiating folds of the mass of prolapsed substance, and snips them away with curved scissors, as in Pl. XXXVIII, Fig. 4. Any arteries that spring are to be promptly secured by ligature, and dressings applied; the contraction of the cicatrices will narrow the orifice so as to prevent the descent of the bowel.

When the prolapsus is very extensive, a large ring of mucous membrane and skin coming down, or being permanently protruded, the entire mass may be removed, either by surrounding it with the *écraseur*, or by cutting away first one half and then the other.

Unless care and judgment are used, so much tissue may be taken away as to produce an excessive narrowing of the anal orifice; a condition not only very distressing, but very difficult to remedy.

§ III. FISSURE OF THE ANUS.

Fissure of the anus.—This most painful affection, consisting in a more or less narrow ulceration of the mucous membrane, which is stretched open at every dilatation of the anus by fecal matter, may be relieved in two ways.

Operation.—(1) *By section.* The patient is laid on the left side, the right leg and thigh well flexed. By means of a bivalve anal speculum, the fissure is brought into full view, and scored with a bistoury in its whole length. One cut is generally sufficient, if it is deep enough to involve about one-half the thickness of the

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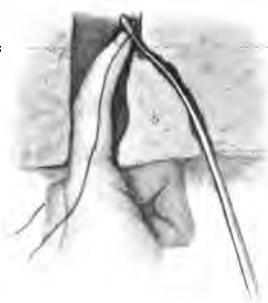
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sphincter muscle. The bowels should be confined by means of opium for four or five days, and then the rectum should be emptied by an emollient enema,—such as flaxseed tea, or thin oatmeal gruel.

(2) By *bursting*. The patient being placed as before mentioned, the surgeon passes his two thumbs, well oiled, into the anus, and then forces them apart, so as to tear asunder the tissues lying at the bottom of the fissure. The subsequent treatment is the same as that after section.

Of these two operations, the first has not once failed to give immediate and permanent relief in a number of cases in which I have used it. The other has the sanction of some high authorities, but is certainly rougher, and perhaps less manageable as to the extent of tissue divided.

§ IV. FISTULA IN ANO.

The three forms of fistula in ano are shown in diagram in Figs. 1, 2, and 3, Pl. XXXIX. Fig. 1 is an incomplete or blind internal fistula, a sinus leading out of the bowel, but not opening through the skin. The sinus is seen at 1, terminating in a cul-de-sac at 2; 3, the cavity of the gut, 4, the anus, 5, the tissue between the gut and the sinus, within which tissue a part at least of the sphincter ani is apt to be comprised.

Fig. 2 is a blind or incomplete external fistula, the opening of the sinus, 1, being at the skin only; a small diverticulum, 2, is seen at one side of it; 3, 4, and 5, as in Fig. 1.

Fig. 3 is a complete fistula, a canal being formed between a point in the gut, 1, and a point in the skin, 2; the other references as in the former figures.

The object of surgical interference is the destruction of the portion of tissue, 5, between the gut and the sinus. The extent of this varies greatly in different cases; sometimes there is but one small sinus, sometimes the tissue of the buttock is burrowed in various directions.

Operation.—By far the shortest way of dealing with a complete fistula is that represented in Fig. 4, Pl. XXXIX. The patient being etherized, if he desires it, the surgeon introduces the forefinger of his left hand into the rectum, its pulp toward the orifice of the fistula, while with his right hand he gently insinuates the blade of a probe-pointed curved bistoury along the

sinus, pushing it clear through into the gut, so that by hooking the left forefinger over the extremity of the knife, it may be so steadied while withdrawn as to divide the whole bridge of tissue.

The knife must be firmly grasped, and prevented from slipping back along the sinus. If well-curved, the probe-point may sometimes be brought out at the anus before the cutting is begun. A little lint, dry or oiled, is inserted into the cut, so as to fill it up from the bottom, and ensure its thorough healing.

When the fistula runs but a short distance up along the bowel, it may be very conveniently operated on as in Fig. 5, by passing a grooved director, curved with its groove on the concave side, through the sinus, and then carrying a knife along it just as in the case of any other fistulous track.

Another method of treatment, which is excellent in many cases, is that by means of the ligature; this is less formidable than the knife, and patients can go about and attend to business during the process of cure. Sometimes the thread, which should be of fine strong silk, may be carried through by means of an eyed probe. When this cannot be done, the plan shown in Fig. 6 is very convenient. A long piece of the silk thread is doubled, and its loop engaged in the nail of the left forefinger, which is passed into the bowel as far as the inner orifice of the fistula. Along this latter channel a probe is now passed, with a somewhat bulbous extremity, which is so manipulated as to get it caught in the loop. The finger is now withdrawn, and the two ends of the thread twisted upon one another until the head of the probe is so grasped that when drawn back through the fistula it carries the thread with it. Now, untwisting the two ends, one is brought down through the sinus, while the other remains in the bowel, hanging out at the anal orifice. We have now a single thread, as in Fig. 7, which is to be tied near the middle of the bridge of tissue, 5, and then twisted until the loop begins to bear somewhat painfully, when it is secured by an adhesive strip. Every day or so the loop is tightened by twisting it in the same way, until it comes off, and leaves the part sound.

‡ V. IMPERFORATE ANUS.

This is of course always a congenital malformation, and must be operated on to save life. It is better to wait until the child becomes uneasy from the accumulation of feces in the rectum,

so that the blind pouch in which the gut terminates may become distended, and may be more readily found. In operating, the best position to place the child in is on the back, with the knees drawn up and flexed, the surgeon sitting or standing directly in front.

Sometimes there is merely a membrane across the anal orifice, and a crucial incision only is needed. Sometimes the point where the anus should be is indicated by a dimple, and by beginning here with a crucial incision, or by making four flaps (with forceps and scissors, as shown in Pl. XXXVIII, Fig. 3), we find a cord of dense areolar tissue, which being cautiously followed up, the terminal cul-de-sac of the rectum is reached. In other cases there is nothing to guide the surgeon, and he can only grope his way, trying to avoid doing injury, by keeping in the median line and just in front of the sacrum, and trusting that he may stumble upon success. (Perhaps in such cases it would be better to attempt lumbar colotomy, although if this were successful, the life thus saved would be one of constant misery to the patient and loathing to his friends.)

CHAPTER VIII.

OPERATIONS ON THE FEMALE GENERATIVE ORGANS.

§ I. LACERATED PERINEUM.

It often happens that, during the expulsion of the child's head in parturition, the fourchette is so violently stretched as to give way. Sometimes the rent is so extensive as to make an operation for its closure necessary. This may either be done immediately after the labor has terminated, or it may be delayed until the patient has recovered her usual condition. (The disadvantage of doing it at once is the risk that the lochial discharges may interfere with the healing; it has, however, been successful in many cases.)

When the operation is done immediately after the labor, the bowels will generally have been well emptied in that process; in old cases of laceration, a purgative should be administered the day before, and an enema on the morning of the operation.

Operation.—Anæsthesia having been induced, the patient is placed in the lithotomy-position, and the perineum shaved. With a sharp scalpel, the operator now freshens a surface three-quarters of an inch or more in width on either side of the fissure, including the edge corresponding to the recto-vaginal septum. (In recent cases this freshening is of course unnecessary.)

Some authorities recommend dividing the sphincter ani on either side with a probe-pointed straight bistoury, outward and backward, each cut being about an inch in depth. This, however, is not essential to the success of the operation.

The next step is the suturing together of the pared or lacerated edges. This may be done either with the quilled or the perforated-shot suture. When the former is chosen, a long curved needle armed with a double thread is entered about an inch from the outer edge of the left hand side of the fissure, and brought out just at the inner edge of the raw surface. It is then passed through the other side in the reverse direction; being entered close to the mucous membrane, and brought out

about an inch from the edge of the skin. Three sutures at least are needful in almost every case, and the one nearest the anus should be passed first. A piece of bougie is now passed through the loops on the one side, and another placed between the ends on the other, which are then drawn tightly, and tied.

Four or five wire sutures are now passed, through the skin only, along the edges of the fissure.

When the shot-suture is preferred, a single wire is passed through the edges at three or four points, at the same distances as the double threads before mentioned. The ends of each wire are now brought together firmly, and passed through a perforated shot, which is pushed home and then pinched tightly; the ends may now be cut off short.

The fissure being closed in either way, cold water dressings are applied, and the patient is laid in bed, on her left side, her knees fastened together with a bandage and drawn up. Opium is freely given, say gr. vj in the twenty-four hours. The urine should be carefully drawn off with a catheter every four hours, none being allowed to escape into the vagina.

Light diet for the first day, and then soups, eggs, etc., may be given; in six or eight days, if all goes well, the patient may try passing water in the kneeling posture, her body resting forward on her elbows.

The sutures may be removed, the deep ones about the third to the sixth day, the superficial about the fifth to the eighth. For two weeks after the operation the bowels should be kept confined, and then carefully opened with emollient enemata.

§ II. OPERATION FOR VESICO-VAGINAL FISTULA.

This excessively troublesome affection is generally the result of injury to the bladder sustained during parturition.

The same preparation is needful as for the operation for laceration of the perineum.

Operation.—The patient being thoroughly etherized, is placed on her knees and elbows, her body supported over a low stool. Sims'* speculum, Fig. 113, is introduced, and the

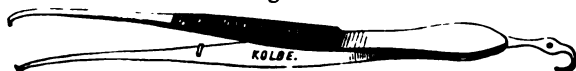
* For the perfection of this operation, the profession are greatly indebted to Dr. Marion Sims, now of New York.

Fig. 118.



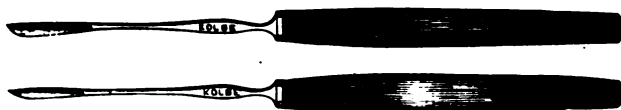
posterior wall of the vagina retracted upward so as to give a full view of the anterior wall. With the forceps, Fig. 114, the

Fig. 114.



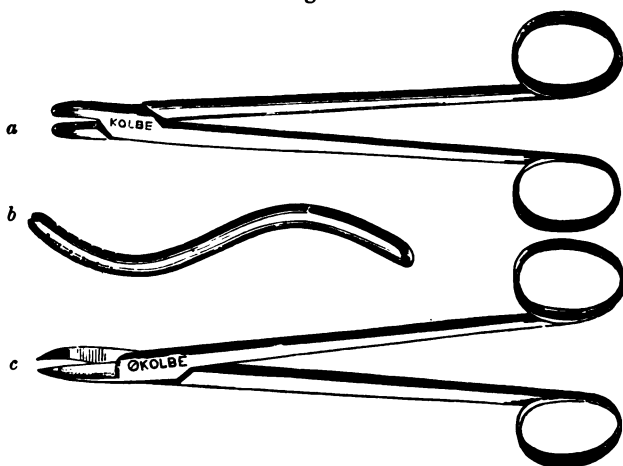
edge of the fistulous opening is now steadied, while with a long scalpel, Fig. 115, it is carefully dissected away all around. The

Fig. 115.



scissors, Fig. 116, *c*, may be used if necessary to complete this process.

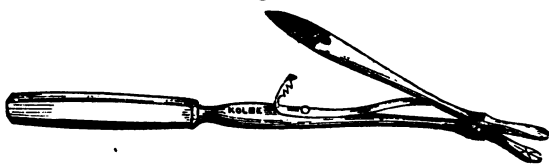
Fig. 116.



The wire-sutures are next introduced by means of a long needle-carrier like that for staphylorrhaphy (Fig. 117). Each

one is entered about a quarter of an inch from the edge of the fissure, and brought out as close as possible to the vesical

Fig. 117.



mucous membrane; re-entered on the other raw surface, and brought out about a quarter of an inch from the vaginal edge. In doing this the hook on the handle-end of the rat-toothed forceps, Fig. 114, is used to steady the tissues while the needle is being pushed through, by pressure on the other side.

Upon each pair of ends a perforated shot* is now placed; the ends are then drawn through the hole in the handle-end of the rat-toothed forceps, by sliding which along the wire the shot is pushed home, when it is clamped with the forceps, Fig. 116, *a*. The ends of the wires are now cut off short, close to the shot, and the operation completed by inserting the double-curved catheter, Fig. 116, *b*, in the bladder.

The patient is placed in bed, her knees tied together, and opium freely administered.

In eight or ten days the sutures are cautiously removed by slightly pulling on the shot with the forceps, dividing the wires on one side with the scissors, and then gently withdrawing them.

Fig. 118.



§ III. OVARIOTOMY.

This very formidable operation, which in a great degree owes its recognition as a proper surgical procedure to the courage and skill of American surgeons, and chiefly to Drs. W. L. Atlee, of Philadelphia, Peaslee, of New York, and Kimball, of Lowell, Mass., depends for its success very much upon the judicious selection of cases. Among the most important points to be decided are, the cystic character of the ovarian tumor,

* To perforate the shot, a punch such as is shown in Fig. 118 may be used.

and its freedom from extensive adhesions, especially to the visceral peritoneum or to the uterus. The settlement of these points in any case involves much tact and discrimination, and they might be dwelt upon at great length, did space permit. Suffice it to say, in general terms, that the chief contraindications are: a distinct history of one or more attacks of peritonitis; marked or persistent functional irregularities, such as obstinate constipation or diarrhœa; or displacement and fixation of the uterus.

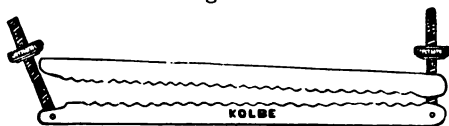
Before instituting so grave a procedure, the surgeon should carefully prepare the patient for it, by regulation of her diet and other habits, and by providing for her suitable attendance during the after-treatment.

Operation.—Anæsthesia should always be induced. The room in which the operation is to be done, and in which the patient is subsequently to lie, must be well ventilated, properly warmed, and afford a good light.

A convenient operating-table should be arranged, covered with folded blankets or comfortables.

The instruments necessary are: scalpels; a director; a large trocar and canula, with a branch to the canula by which an india-rubber tube can be attached; artery-forceps, tenacula, ligatures, wire-sutures and needles, harelip pins, and a clamp (Fig. 119).

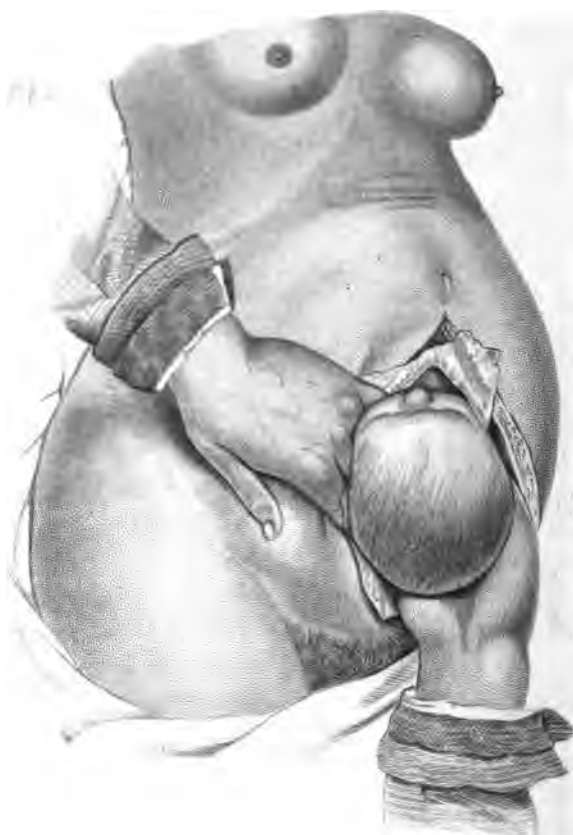
Fig. 119.



The temperature of the room should be kept steadily at 75°, and the air moistened if needful by the evaporation of water from a wide shallow vessel.

Everything being ready, the patient is etherized and placed on the operating-table, resting with her hips at its edge, her head and shoulders slightly raised, and her feet supported on two chairs, with the knees well separated. The surgeon, standing directly in front, makes an incision in the median line, a little below the umbilicus, about three inches long. Successive layers of tissue are divided, until by laying open the peritoneum the ovarian tumor is brought into view. As soon as this is fairly done, the surgeon slips his fingers in over the surface of





the exposed cyst, to see that it is free from adhesions. With the trocar and canula, he next penetrates it, and draws off as much of the contents as possible. Other cysts may now be tapped in like manner, the incision through the parietes of the abdomen being enlarged if needful, until the mass of disease is so reduced as to be removable through the opening. This being done, the pedicle is embraced in the clamp (Fig. 119), which is securely fastened, the peritoneum cleansed, and all hemorrhage carefully checked.

The clamp is now placed across the lower part of the external wound, which is accurately closed throughout its whole extent by means of sutures (interrupted or harelip) and very lightly covered with wet lint. A full anodyne is given either by suppository or by hypodermic injection, and the patient laid in bed; the utmost quiet is to be observed, and light but nutritious food given.

Adhesion between the pedicle and the edges of the abdominal wound is expected to take place, and the clamp will gradually become loosened by the shrinking of the tissues embraced in it.

Fig. 1, Pl. XXXVIII, shows the cutting off of the pedicle after the clamp has been applied.

§ IV. CÆSAREAN SECTION.

It sometimes happens that a living child cannot be born, whether from contraction of the mother's pelvis, or from rupture of the uterus during labor. Or, the mother dying suddenly while in labor, it becomes necessary to attempt saving the child's life by instantly extracting it.

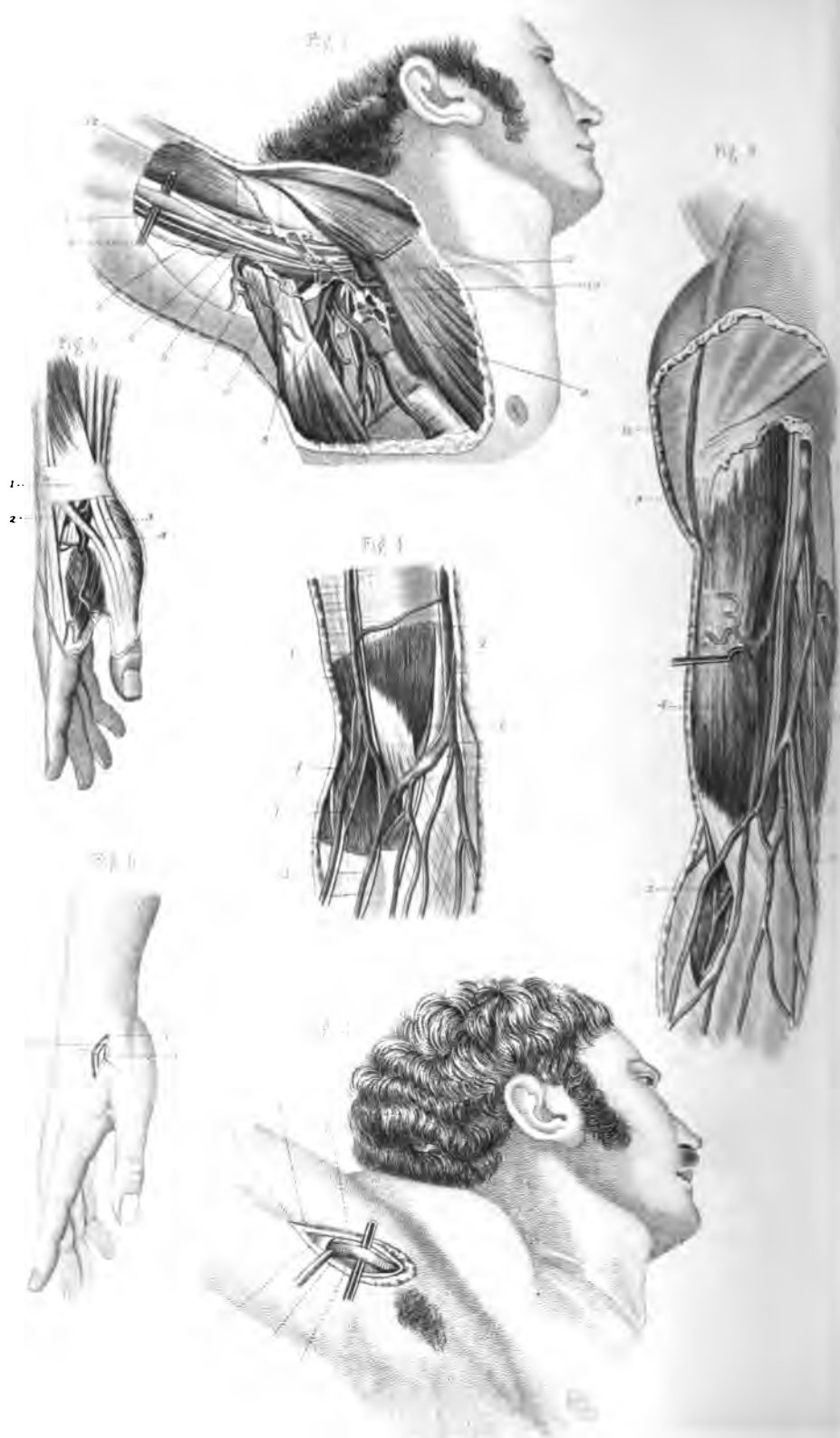
Operation.—If there is time, the same precautions are to be taken as for ovariectomy.

The instruments and preparations required are also the same, with the exception of the trocar and canula.

An incision is made in the median line, just below the umbilicus; usually there is nothing between the abdominal wall and the uterus, which is readily reached and laid open, when the child is at once extracted, as in Fig. 2, Pl. XXXVIII. Care is required to completely remove the membranes and placenta. Sometimes assistants have to keep the intestines from protruding through the wound.

When the mother is living, the contractions of the intrinsic muscles of the womb are usually sufficient to arrest all hemorrhage, and to prevent gaping of the uterine wound; if not, they may be stimulated by applying pure cold water.

Accurate closing of the abdominal orifice, by deeply placed sutures, and a subsequent treatment like that of ovariectomy, complete the operation.



CHAPTER IX.

LIGATION OF ARTERIES IN THE LIMBS.

§I. LIGATION OF THE ARTERIES OF THE UPPER EXTREMITY.

(1) **Ligation of the axillary artery.**—This operation is sometimes necessary for aneurism, but is not often done, since it is easier to tie the vessel in other portions of its course, where it is less abundantly surrounded with nerves, and gives off fewer branches.

Surgical Anatomy (Fig. 1, Pl. XLI).—The continuation of the subclavian artery is called axillary from the edge of the first rib to the outer edge of the *teres major* muscle. It is divided into three stages: the first extending from the edge of the rib to the edge of the *pectoralis minor*, the second being the part behind this muscle, and the third the portion between this and the lower border of the *teres major*.

Throughout its whole course, this artery is in relation with the large nerves going to the upper extremity, and with veins of considerable size. It is deepest above, and its vein lies at its inner side.

On account of the large number of branches given off by the axillary artery (the four thoracic, the subscapular, and the two circumflex), the point selected is generally that indicated in Fig. 2, Pl. XLI, viz., as far as possible below the origin of the subscapular.

Fig. 1, Pl. XLI. Axillary artery, 1, with a director, 2, passed under its continuation (the brachial), 3, median nerve, embracing the artery by its two heads. 4, internal cutaneous nerve. 5, ulnar nerve. 6, axillary vein, lying at the inner side of the artery. 7, lymphatic glands and vessels of the axilla. 8, thoracic branches, given off from the axillary artery before it emerges from beneath the *pectoralis minor* muscle, 9. 10, *pectoralis major* muscle, held back by a blunt hook, 11. 12, *coraco-brachialis* muscle. 13, biceps.

Fig. 2, Pl. XLI. Operation of tying the axillary artery. 1, the edge of the skin; 2, edge of the superficial fascia; 3, sheath of the vessels. 4, the artery, with a director passed beneath it. 5, vein, held away by a blunt hook. 6, median nerve. 7, internal cutaneous nerve.

Operation.—The patient being etherized, and placed on his back, the shoulder is elevated, and the arm drawn far up away from the body. An incision three inches long is now made through the skin and superficial fascia, just below the edge

of the coraco-brachialis and parallel to it; the inner end of this incision just reaches the deepest point of the axilla. Some space is gained by making it somewhat curved, with its convexity downward. The fibres of the pectoralis major, being brought into view, are divided, and retract.

The arm is now brought downward toward the side, when the pectoralis minor will be relaxed, and may be drawn aside downward and outward. In order to expose the artery, which may be felt beating, the costo-coracoid membrane must be scratched through, the nerves drawn outward, the vein downward and inward. The ligature is to be passed from within outward.

Another plan, which may be employed if the patient is not very muscular, is to separate the pectoralis major and deltoid muscles, instead of dividing the former.

When for any reason it is decided to tie the artery in the second stage, just as it passes behind the pectoralis minor muscle, the incision through the skin must be longer (say five inches at least), and parallel with the clavicle. The muscular fibres may either be cut through, or held aside; if cut through, the arm should be stretched upward, so as to make a small division answer, but if they are held aside, the arm should be brought downward, so as to relax them. Probably the greater facility of access to the vessel would make the former course preferable, and in any case grave enough to require such an operation, the cutting of the muscular fibres would be of relatively small moment.

Ligation of the axillary artery in its third stage is easily done by an incision two and a half or three inches long, parallel with the edge of the pectoralis major muscle. The skin, superficialis fascia, and deep fascia have to be divided, and the artery separated from the veins and nerves. The ligature must be applied as low down as possible, in order to avoid the neighborhood of the origin of the subscapular artery.

(2) Ligation of the Brachial Artery.

Surgical Anatomy (Fig. 3, Pl. XLI).—1, brachial or humeral artery. 2, radial. 3, coraco-brachialis muscle. 4, biceps. 5, median nerve. 6, brachial or humeral vein. 7, profunda major artery. 8, ulnar nerve. 9, process of fascia given off from the biceps tendon, and covering the artery at the bend of the elbow. 10, median basilic vein; 11, cephalic vein.

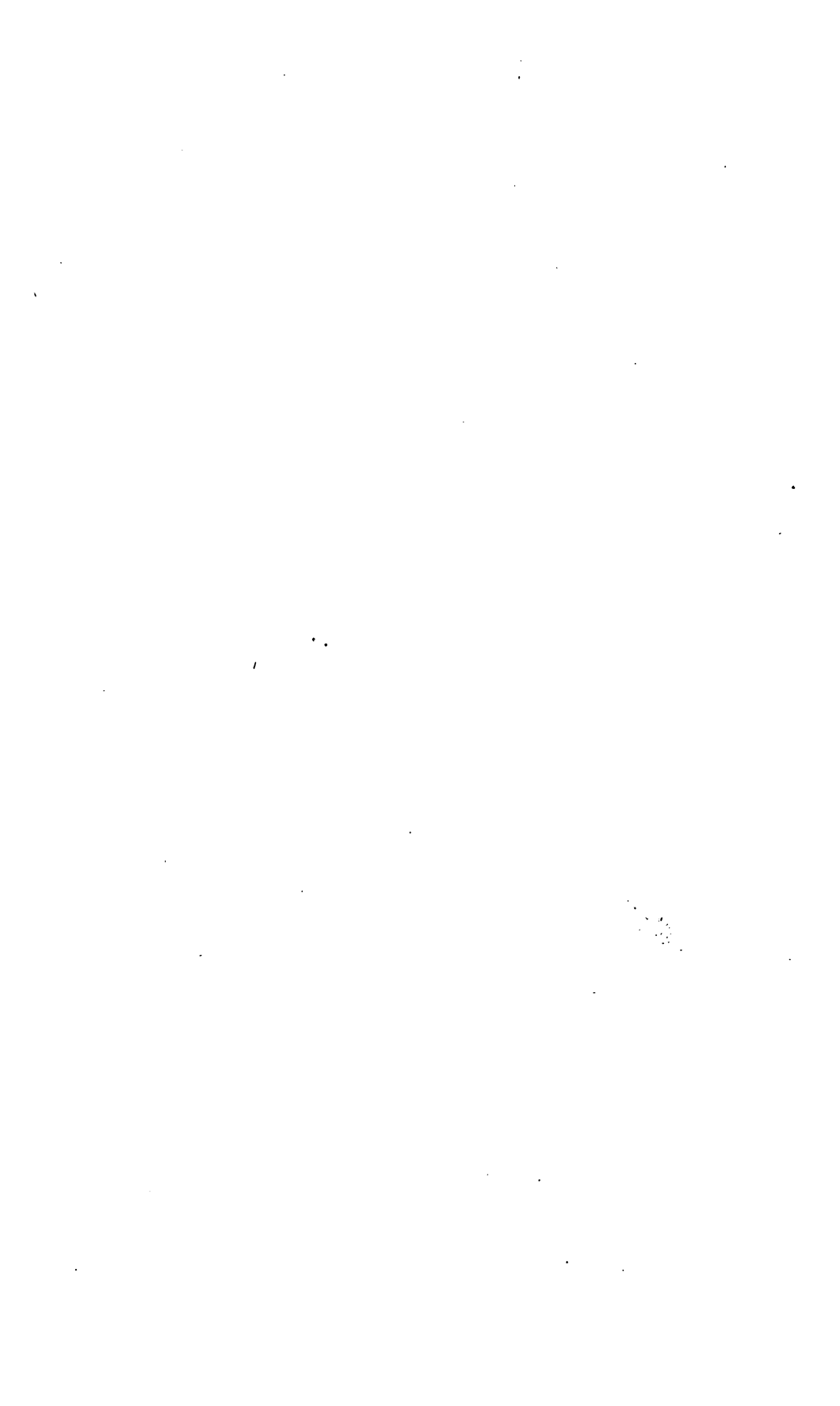


Fig 1

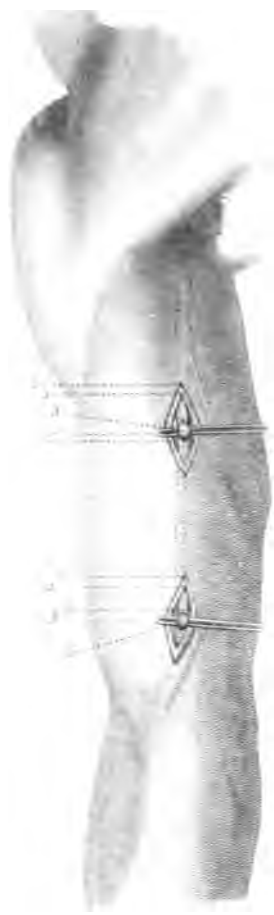


Fig 2



Fig 3

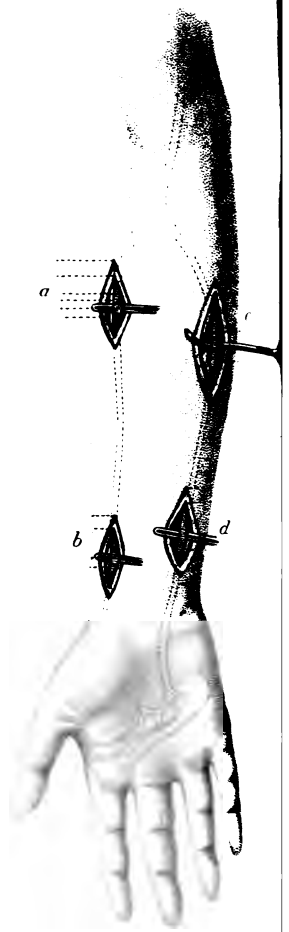


Fig 4



Fig 5



Operation.—It is obvious from this that the brachial artery may be tied at almost any point of its course. In Pl. XLII, Fig. 1, the vessel is seen exposed at two points. An incision two and a half to three inches long, according to the size of the limb and the amount of fat it contains, is made along the inner side of the prominence formed by the biceps muscle. Successive layers of fascia are pinched up, nicked, and divided on a director, the vein and nerves held out of the way, and the aneurism-needle passed from within outward.

When the artery bifurcates high up, we must secure both branches, lest the aneurism or bleeding necessitating the operation, although controlled for the time, should be troublesome again when the circulation is fully restored through the distal portions of the vessels of the limb.

[The arrangement of the veins of the upper limb is shown in Figs. 3 and 4, Pl. XLI; it was formerly, when venesection was constantly practised, a matter of greater surgical interest than now.

The veins are, as in the leg, divided into the superficial set and the deep. The superficial, coming up from the hand along the front of the forearm, somewhat irregularly, form at or near the bend of the elbow three principal trunks; one at the radial, one at the ulnar side, and one, the median, between the other two. A large communicating branch comes from the deep veins to the median, which then divides into two branches: one, the median cephalic, going to the radial or cephalic vein, and the other, the median basilic, going to the ulnar or basilic vein.

In Fig. 3, the basilic vein is shown at 10, running up the inner side of the arm, the cephalic, 11, passing up between the pectoralis major and deltoid muscles.

In Fig. 4, the relations of the superficial parts about the bend of the elbow are shown more in detail. 1, 1, the cephalic vein; 2, 2, the basilic; 3, the median; 4, the median cephalic; 5, the median basilic; 6, the brachial artery.

The nervous filaments seen about the cephalic vein, below the elbow, are branches of the external cutaneous; above the elbow, of the musculo-spiral. Those about the basilic vein are derived from the anterior branch of the internal cutaneous.]

(3) Ligation of the Radial and Ulnar Arteries.

Surgical Anatomy.—In Fig. 2, Pl. XLII, a view is given of the anatomy of the radial and ulnar arteries. The brachial artery, 1, passes under the process of fascia given off from the biceps, and divides into the radial, 2, and the ulnar, 3. Just above the wrist, the radial, 4, and the ulnar, 5, are seen accompanied by the nerves of corresponding name. Each artery has two veins, one on either side of it; 6, 6, are the radial, and 7, 7, the ulnar. The median nerve, 8, is seen crossing in front of the ulnar artery near its origin, and dip-

ping with the interosseous branch of that artery, through the intermuscular space. At 9, the ultimate portion of the ulnar artery, the superficial palmar arch, is seen.

It will therefore appear that the radial artery runs down the outer side of the forearm, along the inner edge of the supinator longus muscle, 10; while the ulnar lies deeply beneath the mass of flexors and pronators at the upper and inner side.

Ligation of the radial.—(1) In its upper part.—If the inner edge of the supinator longus muscle can be felt, it forms a guide; if not, an incision two inches or more in length is to be made in a line from the middle of the bend of the elbow to the styloid process of the radius, the edge of the muscle traced and held aside, and the fascia divided in the usual way. (See Pl. XLII, Fig. 3, *a*.)

(2) In its lower part.—Here the pulsations of the vessel may be generally felt; if not, an incision made in the interspace between the tendons of the supinator longus and the palmaris longus, about one inch above the wrist, will enable the surgeon to expose the vessel (Fig. 3, *b*).

Ligation of the ulnar.—At its upper part this vessel lies so deeply that it is only tied when a wound in that vicinity is bleeding very profusely; the incision required would be very large, at least three and a half inches (Pl. XLII, Fig. 3, *c*), a great mass of muscle must be divided, and the operation would be by no means easy.

At the lower portion of the limb, the ulnar can be easily tied, by an incision about two inches long, at the radial side of the flexor carpi ulnaris tendon, between which and the flexor sublimis digitorum access is at once gained to the vessel (Fig. 3, *d*).

Ligation of the radial artery at the back of the wrist is shown in Figs. 5 and 6, Pl. XLI. In Fig. 5 the artery is seen after it has wound over the lower end of the radius to get to the back of the wrist, where it runs beneath the extensor tendons of the thumb to get to the second interosseous space. It is seen between the extensor of the first phalanx and that of the second, in the deep hollow so marked when these muscles are brought into strong action; and may be cut down upon here by an incision about one inch in length, as shown in Fig. 6. The pulsations of the vessel furnish a guide to it.



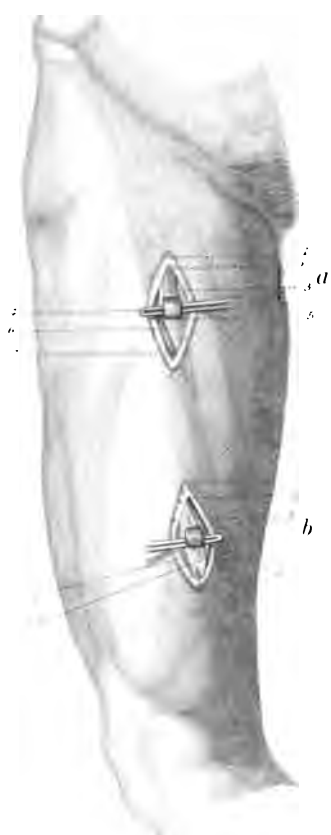


Fig. 3.

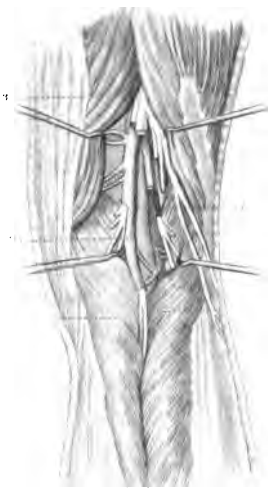


Fig. 4.

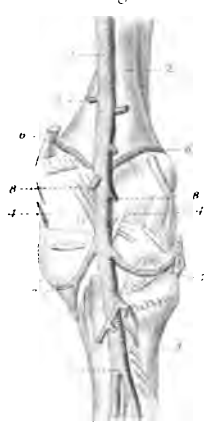


Fig. 5.



§ II. LIGATION OF THE ARTERIES OF THE LOWER EXTREMITY.

(1) **Ligation of the femoral artery.**—This operation has been perhaps oftener done, and with a greater degree of success, than the ligation of any other artery. It is most frequently rendered necessary by popliteal aneurism, but may be required for the arrest of bleeding from a wound.

Surgical Anatomy.—The femoral artery begins at the brim of the pelvis, the external iliac passing under Poupart's ligament at a point about midway between the symphysis pubis and the anterior superior spine of the ilium; a line drawn from this point to the inner side of the inner condyle of the femur corresponds closely with the course of the vessel (Fig. 1, Pl. XLIII). At about the junction of the middle and lower thirds of the thigh, the artery passes through an opening in the adductor magnus muscle, and becomes popliteal.

The vein lies close to the artery, enclosed with it in a sheath; above, it is at the inner side, then gets behind it, and at the lower part of the thigh is at the outer side.

The artery, in passing down the thigh, gives off only one branch, the profunda or deep femoral, which supplies the muscles.

Operation.—The best place to expose the artery is four or five inches below the fold of the groin (Pl. XLIII, Fig. 2, *a*). The patient being laid on his back, the limb somewhat flexed and abducted, an incision three inches in length is made toward the apex of the triangle whose base is Poupart's ligament, and the sides of which are formed by the sartorius and adductor longus muscles. In doing this, care must be taken to avoid superficial veins. Next, the fascia lata is divided, and then the sartorius muscle is drawn outward with a blunt hook. The pulsations of the artery are next felt for, and the sheath cautiously opened in the usual way, avoiding a small branch of the internal cutaneous nerve, which usually lies upon it. In passing the aneurism-needle, it must be carried from within outward, and kept close to the artery, so as not to wound the vein lying beside it.

The femoral artery may also be tied in its lower part, just before it passes through the adductor magnus muscle (Pl. XLIII, Fig. 2, *b*). The patient is placed in the same position as in the preceding operation. If the limb is a thin one, the surgeon feels the anterior edge of the sartorius muscle, and makes an incision three inches long, nearly parallel to this, but very slightly

behind or within it. Exposing the muscle, he draws it *inward* with a blunt hook, which he confides to an assistant, and then divides the fascia between the adductors and the vastus internus, when access to the sheath of the vessel will be easy. This being laid open, the aneurism-needle is passed from without inward, entering between the vein and artery.

(2) Ligation of the Popliteal Artery.

Surgical Anatomy.—The popliteal artery is the continuation of the femoral, from the adductor magnus muscle to the lower edge of the popliteus. Fig. 1, Pl. XLIV, shows a dissection of the popliteal space in the right limb. Part of the aponeurosis has been removed. 1, external saphena vein. 2, popliteal nerve; 3, peroneal nerve; 4, external or short saphenous nerve; 5, cutaneous branch of peroneal nerve; 6, long saphenous nerve; 7, 7, hamstring muscles. 8, 8, superficial veins; 9, internal saphena vein.

Fig. 3, Pl. XLIII, shows this region with the aponeurosis removed; 1 is the popliteal artery, 2, the vein of the same name. 3, the semi-membranosus and semi-tendinosus muscles drawn aside; 4, the biceps; 5, 5, the two heads of the gastrocnemius, also drawn aside; 6, the popliteal nerve, cut off so as to afford a better view; 7, the peroneal or external popliteal nerve.

It will therefore be seen that in the popliteal space the vein and nerve are both superficial to the artery, although the vein gets across to its inner side as it descends.

Fig. 4 shows still more clearly the closeness of the artery to the bone. Lying upon its inner side, it gets behind it to the space between the condyles, running down just at the back of the knee-joint. Given off from it in this course, besides the three pair of articular arteries, are several small muscular branches. A little above the bifurcation into the peroneal and the posterior tibial, the anterior tibial comes off, and passes at once through the interosseous ligament.

In Pl. XLIV, Fig. 3, a section shows the artery in the position above mentioned.

Operation.—The patient being etherized and placed on his belly, with the knee extended, an incision three inches long is made at the outer border of the semi-membranosus muscle, as seen in Fig. 5, Pl. XLIII (on the right limb). The fascia being divided, the muscle drawn aside inward, and the artery felt beating, the aneurism-needle is passed around the vessel from without inward, thus avoiding the vein and nerve, which lie toward the outer side of it.

Care should be taken to tie the artery as far as possible *below* the point at which the branches are given off.

(3) Ligation of the Posterior Tibial Artery.

Surgical Anatomy.—(See Pl. XLIV, Fig. 4.) This vessel lies behind the tibia, and in order to reach it the muscles must be drawn aside. 1, the artery. 2, 3, its accompanying veins. 4, 4, the internal saphena vein. 5, the fascia of the leg. 6, 6, hooks holding aside the fascia in front and the soleus muscle posteriorly. 7, the tibialis posticus muscle, drawn forward. 8, the flexor longus digitorum pedis. 9, the annular ligament of the ankle. 10, the tendo Achillis.

Operation.—(Pl. XLIII, Fig. 6.) The patient being etherized and laid on his back, the leg flexed on the thigh, the thigh flexed on the pelvis, and the whole limb laid on its outer side, an incision about four inches in length is made along the edge of the tibia, a little above its middle, avoiding the saphena vein. The edge of the gastrocnemius being exposed, this muscle is drawn backward with a blunt hook. The fibres of the soleus are next divided upon a director, passed under them. Now, pushing his right forefinger deep into the wound, the surgeon feels for the pulsations of the vessel, and with a forceps in his left hand pinches up the fascia covering it. He next nicks the fascia, passes a director under it, cuts it, and repeats this process until the artery is exposed. The aneurism-needle is to be passed from without inward, avoiding the posterior tibial nerve.

The operation is easier in the lower third of the leg (Fig. 6, b). Here an incision about three inches in length is made near the inner edge of the tendo Achillis, and parallel with it; always avoiding the internal saphena vein. Following down in the intermuscular space, the artery is found at the posterior margin of the long flexor of the toes. The aneurism-needle is passed, as before, from without inward.

The artery may also be secured just behind the malleolus. An incision two inches or more in length is made about an inch posterior to the inner malleolus, and the various layers of fascia, as well as the annular ligament, divided on a director. The artery is now found by its pulsations, exposed, and the aneurism-needle insinuated beneath it from behind forward.

(4) Ligation of the Anterior Tibial Artery.

Surgical Anatomy.—This vessel is the anterior branch of the two into which the popliteal divides at the lower edge of the popliteus muscle. It passes immediately forward through an opening in the interosseous ligament, and then

along the front of that membrane, in a line from the inner side of the fibula to the centre of the ankle.

Fig. 5, Pl. XLIV; 1, anterior tibial artery. 2, 2, its accompanying veins. 3, anterior tibial nerve. 8, tibialis anticus, held aside with a hook. 9, the extensor proprius pollicis pedis, also held aside with a hook. 12, the dorsalis pedis artery, or terminal portion of the anterior tibial.

Operation.—The anterior tibial may be tied in the upper part of the leg (Pl. XLIV, Fig. 6, *a*), but with some difficulty on account of its depth. An incision at least four inches in length must be made, parallel with the spine of the tibia, and about half way between it and the outer edge of the fibula. Through the interspace between the tibialis anticus and extensor longus digitorum muscles (relaxed by flexing the foot), the surgeon now works his way with the finger and the handle of the knife, until he exposes the artery, lying on the interosseous ligament, with the nerve at its outer side. The aneurism-needle is carefully passed around the vessel, between it and the two accompanying veins, one on either side.

In the lower third of the leg (Fig. 6, *b*), the anterior tibial artery can be more readily secured. An incision two and a half to three inches long is made between the tendons of the tibialis anticus and extensor proprius pollicis pedis. Relaxing these tendons by flexing the foot, and drawing them aside, the vessel is felt pulsating; the anterior tibial nerve, which lies in front, is held out of the way, and the aneurism-needle passed around the artery, between it and the veins.

Ligation of the Peroneal Artery.

Surgical Anatomy.—(Pl. XLIV, Fig. 5.) This vessel comes off from the posterior tibial an inch or so below the edge of the popliteus muscle, and runs down the leg close behind and to the inner side of the fibula. It is seen at 4, the long flexor of the great toe being pushed backward by the needle, inserted between the nerve and artery.

Operation.—The patient being etherized and laid semi-prone, the leg is supported so as to expose its outer surface. The surgeon now makes an incision two to two and a half inches in length, parallel to the posterior edge of the fibula, and about half an inch behind it (Pl. XLIV, Fig. 6, *c*); in doing this he guards against injuring the external saphena vein or any large branch of it. Getting into the interspace between the peroneal muscles and

Fig. 1.

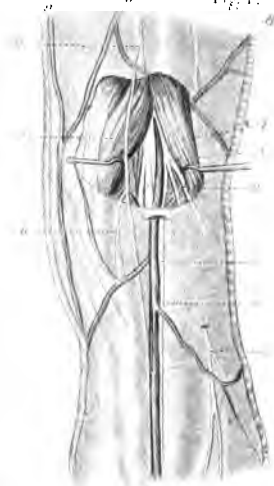


Fig. 2.



Fig. 3.



Fig. 5.

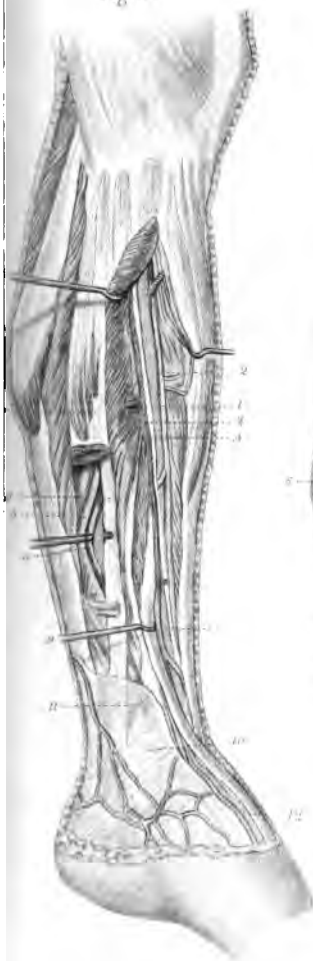


Fig. 6.

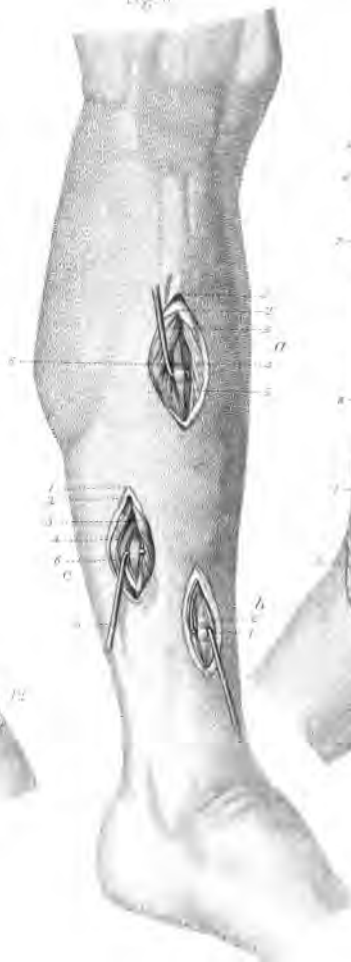


Fig. 7.



the long flexor of the great toe, he works with the finger and handle of the knife until he feels the pulsation of the artery at the back of the bone, the muscles being relaxed as much as possible. Care must be taken to pass the ligature around the artery alone.

Ligation of the Dorsalis Pedis Artery.

Surgical Anatomy.—Fig. 4, Pl. XLII, shows the relations of the dorsalis pedis artery. It lies just at the outer side of the tendon of the extensor muscle of the great toe. 1, artery. 2, extensor tendon. 3, annular ligament of ankle. 4, extensor brevis digitorum muscle.

Operation.—(Fig. 5, Pl. XLII.) An incision one and a half or two inches in length is made just below the bend of the ankle, and at the outer side of the extensor tendon. The artery is easily exposed, and the aneurism-needle passed from within outward.

CHAPTER X.

RESECTIONS OR EXCISIONS OF THE JOINTS; AND OF BONES.

THESE procedures have for some reason found more favor among British surgeons and those in some Continental cities, than in our own country. They require judgment and skill on the part of the operator, endurance and courage on the part of the patient.

Various points are to be considered in regard to cases calling for a choice between resection and amputation: the state of the soft parts; the state of the periosteum; the extent of bone diseased; the involvement of one or of both the constituent parts of the joint; the object to be aimed at,—whether a movable or a consolidated condition of the bones; the age, medical history, and constitution or vital power of the patient.

If the soft parts are very flabby and much broken down; if the periosteum is greatly thickened and diseased; if a large part of both or all the bones composing the joint is affected; if the patient is at or beyond middle age, has been suffering long, and is “demoralized,” amputation is more promising of success. But in a child or young person, whose trouble is of recent date, with no great affection of the soft parts, and when but one bone, or but a small portion of each is involved, resection may be resorted to with some degree of hope.

We have, in these operations, to make our incisions so as to give us free access to the diseased bones, avoiding if possible the division of vessels, nerves, and tendons; and so as to provide for the escape of pus during the subsequent treatment. Often the sinuses which exist in the neighborhood may be followed with advantage.

Anæsthesia ought always to be induced, as these procedures are often not only painful, but tedious.

The instruments required are: scalpels, bistouries, and grooved directors for dividing the soft parts; dilators, blunt hooks, linen or muslin retractors, elevators, or the bone-director.

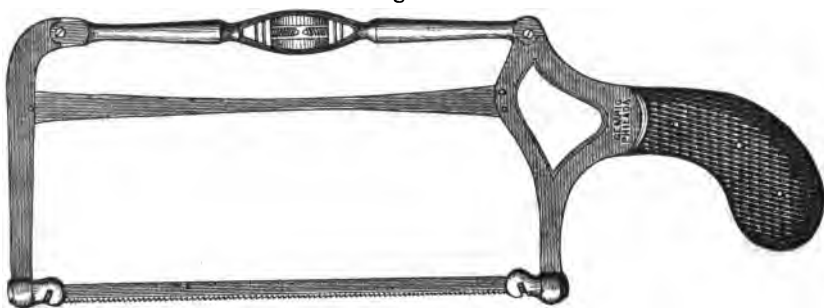
(This last-named instrument is simply a large director, about ten inches in length; it is shaped like a sound for the urethra,

and the groove extends along its back from the handle to the curve, or about six inches. It can therefore be readily insinuated around a bone which is to be sawn through, and rotated so as to bring its groove next to the bone; a chain-saw may now be passed along the groove, or, if the ordinary saw be used, the soft parts are effectually held out of the way.)

For grasping and steadying the bone, various forms of forceps will be found useful: Fergusson's lion-jawed, Fig. 64 (p. 73), or the ordinary duck-bill, straight or curved.

For dividing the bone, we may employ the common amputating saw, or Butcher's, Fig. 120, the blade being movable, so that it may be set at any desired angle. Occasionally the chain-

Fig. 120.



saw, or a very narrow-bladed saw (sometimes called a "metacarpal" saw), may answer a good purpose. The operator should also be provided with bone-nippers of various shapes, chisels and gouges, and a trephine. Artery-forceps, a tenaculum, ligatures, sponges, etc., must be at hand.

§ I. RESECTION OF THE JOINTS OF THE UPPER EXTREMITY.

Resection of the shoulder-joint.—This may be required in cases of gunshot wound, or of disease. The chances of success are much greater if the glenoid cavity is healthy.

The patient being laid on his back on a strong table, with the affected shoulder raised and well exposed over the edge, an assistant compresses the subclavian artery against the first rib. In making the division of the soft parts, the surgeon may cut straight down parallel with the fibres of the deltoid, from a point a little back of the coracoid process, or he may make a

flap of the muscle, cutting from without inward, as in Fig. 1, Pl. XLV. Reaching the cavity of the joint, he frees the long tendon of the biceps so that an assistant may draw it forward with a blunt hook. Then, another assistant rotating the arm, the muscles surrounding the joint are quickly divided, and by bringing the elbow toward the side, the head of the bone can be tilted out and sawed off.

If the chain-saw be used, it is simply slipped over the bone; if any other, the bone-director or some form of retractor or guard for the soft parts must be employed.

If the glenoid portion of the scapula be diseased, it can be cut away with strong bone-nippers.

The pressure on the subclavian artery is now relaxed; any vessels that spring are tied; the wound is closed with adhesive strips, dressed with cold water, laudanum, or solution of carbolic acid, and the limb carefully supported parallel with the body. A pasteboard or tin trough answers a good purpose in keeping it steady for the first few days.

Another plan, shown in Fig. 2, Pl. XLV, is to transfix the soft parts with a catlin, as if to make a deltoid flap, and to cut downward for three or four inches; then, the knife being withdrawn, a linen retractor is passed above, and another below the bone, which is divided with the chain-saw. The upper portion may now be grasped with forceps, rotated, and its connections with the joint severed by touches with the knife.

To this method there is the objection that the surgeon must work with greater difficulty, and that the bleeding vessels are less readily secured, than by the others mentioned.

Resection of the elbow.—This operation is one of the most generally successful of its class. It must of course be done from behind (the large vessels being in front), and the ulnar nerve must be guarded from injury.

Operation.—Access to the part is best gained by turning the patient on his belly, the limb to be operated on being supported over the edge of the bed by an assistant. The surgeon stands so as to have the joint at his left; *i.e.*, on the inner side of the left arm, on the outer side of the right. If no sinuses exist, and he has therefore no plan marked out for him, he had better make a rectangular flap, such as is shown turned up in Fig. 3, Pl. XLV, and sutured in Fig. 4. This flap should be as wide as the joint, but the inner longitudinal incision must be made

Fig. 1.

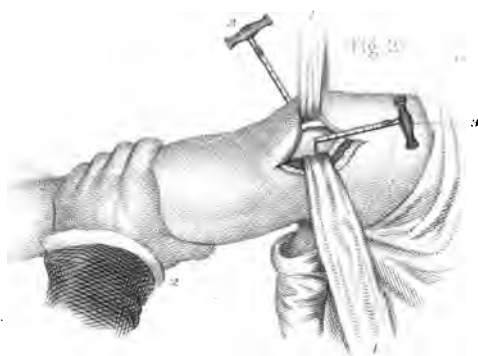
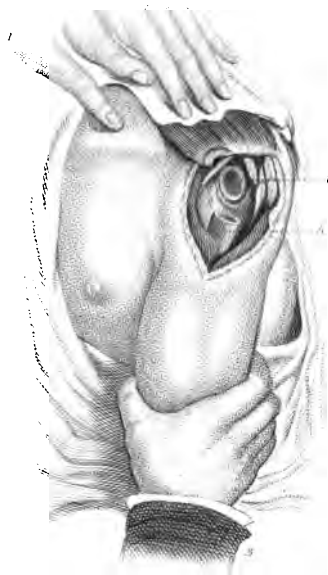


Fig. 3.

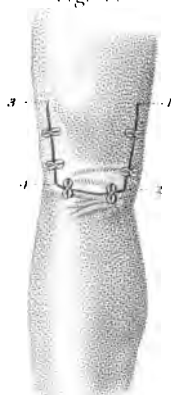


Fig. 4.



Fig. 5.

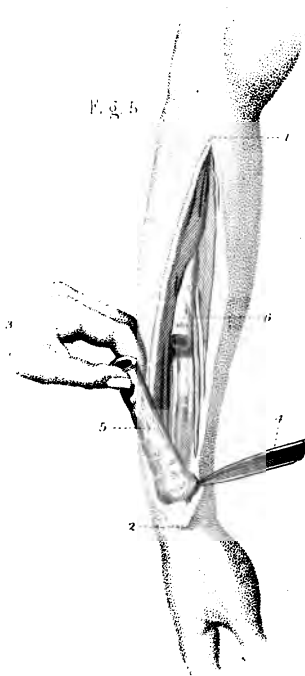


Fig. 6.

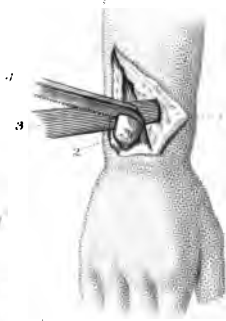
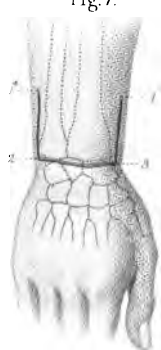


Fig. 7.



just to the radial side of the ulnar nerve, which lies in the groove behind the inner condyle. When the disease is extensive in the ulna or radius, or both, an H-shaped cut may be made, the transverse portion corresponding to the tip of the olecranon. In cutting the flap or flaps, all the tissues are to be divided, down to the bone; and if possible, the periosteum should be divided and stripped up with the other soft parts, so as to afford a chance for the development of new bone.

The flaps being turned up, the ulna is tilted backward out of the wound, a strip of wood placed under it, or a retractor, and the articular portion, with as much more as is deemed necessary, sawed off. Next, the head of the radius, if diseased, and if the saw has not already cut it through, is removed either with the saw or with bone-nippers. Lastly, the end of the humerus is in like manner tilted backward and sawed through. All bleeding vessels are now secured, and the wound closed with sutures; cold or warm water, with carbolic acid, or lead-water and laudanum, applied, and the limb is placed on a pillow, in any easy position, the patient being laid on his back. A splint is required only when there is great restlessness. After a few days, the patient may be allowed to get up, with the limb supported with a splint and sling. Almost always, fibrous tissue is developed between the sawn bones, and a good deal of use, of the forearm and hand especially, is acquired. I have several letters written me by a man, whose right elbow I excised in 1862 for a gunshot wound received some six weeks previous to the operation.

Resection of the wrist-joint.—This joint has been occasionally resected, either wholly or in part, with some success; but on account of the small amount of tissue covering it (and what there is consists in great degree of tendons), as well as the fact that the usefulness of the hand depends upon the freedom and ease of its motions, it is a less favorable place for operations of this kind than the elbow. In 1857 I obtained a very good result in a case of necrosis, removing the ends of both bones.

The remaining three figures in Pl. XLV show some of the operations in question.

Fig. 5 represents the removal of the lower portion of the radius, by a single longitudinal incision along its border. The bone having been sawn through as high as is necessary, is tilted out, and its lower attachments divided by touches with a bistoury.

Fig. 6 represents the removal of the lower end of the ulna, a triangular flap being turned up so as to expose it, a strip of wood passed between it and the soft parts, and the saw applied.

In Fig. 7 the flap for removal of the lower ends of both the radius and ulna is shown. The transverse incision is on a level with the first row of carpal bones.

§ II. RESECTIONS OF THE JOINTS OF THE LOWER EXTREMITY.

Resection of the hip.—There are two entirely distinct classes of cases in which a surgeon might feel called upon to do operations which would come under this head:

(1) Cases of ankylosis, the hip-joint being consolidated at an inconvenient angle, and the object being either to take away a portion of the femur near its head so as to correct the line of the lower limb, or to establish a ligamentous union which shall substitute as far as may be the original joint.

(2) Cases of gunshot injury or disease of the hip-joint, or *morbus coxarius*, in which the removal of the shattered or diseased head of the femur, and perhaps of part of the acetabulum, is called for, in the hope that there will be either fibrous or bony union established between the remainder of the bone and the os innominatum.

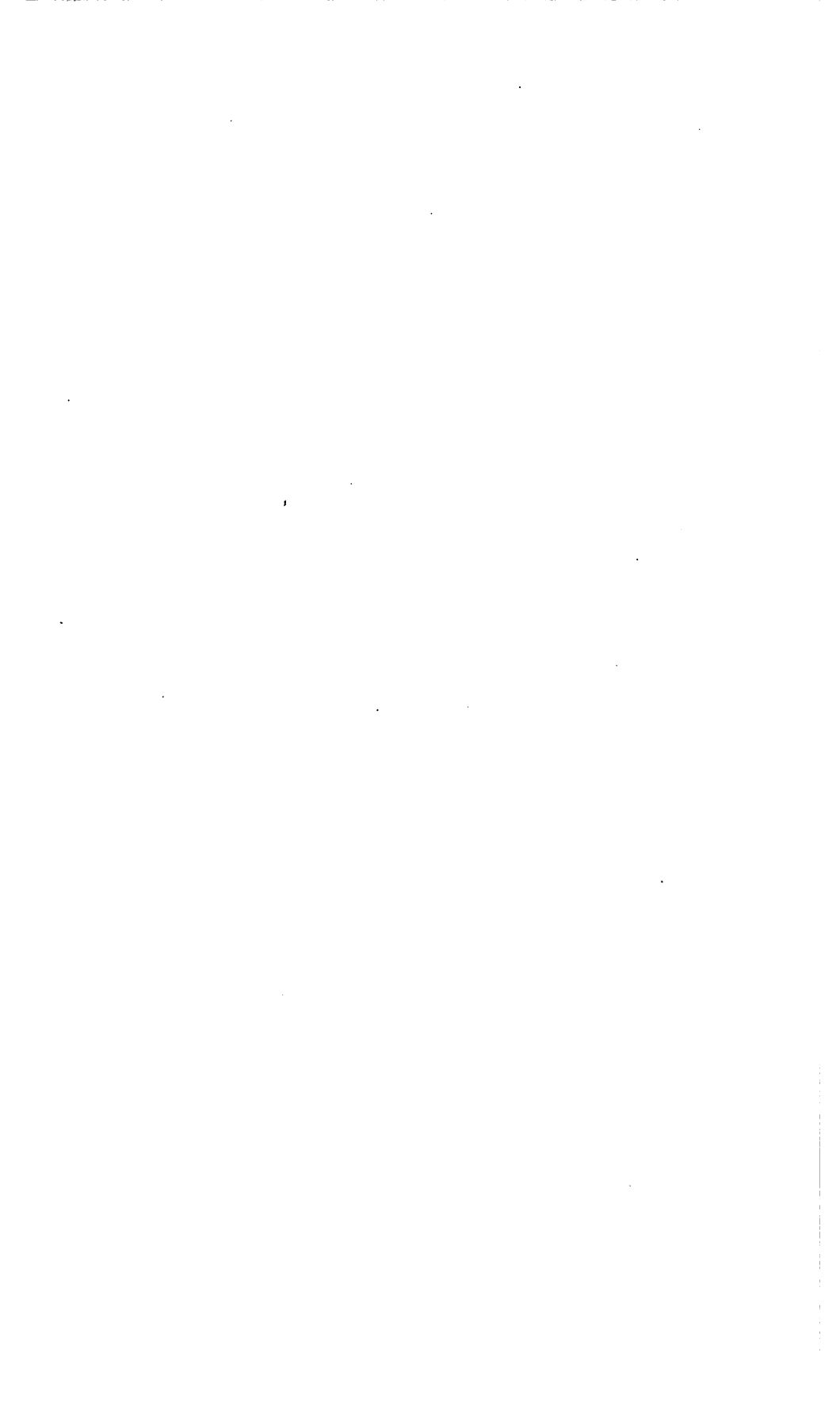
Cases of the first class are of course very rare in civil practice. According to Circular No. 2, S. G. O., U. S. A. War Dept., the death rate in cases operated on by military surgeons has been 90.6 per cent.

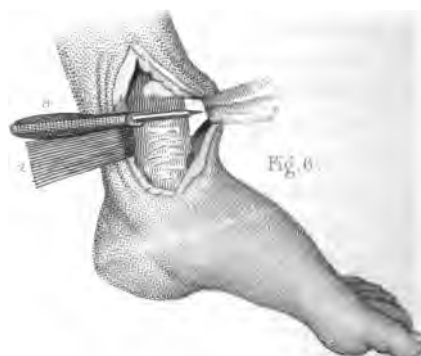
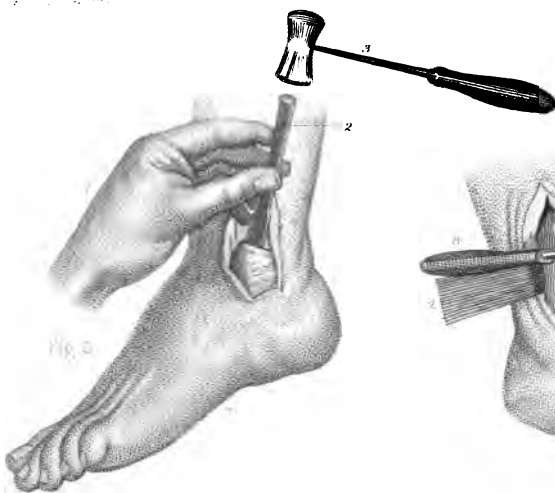
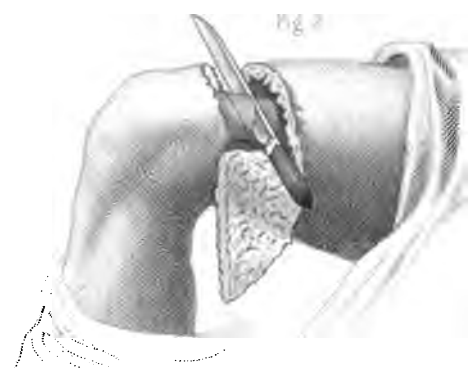
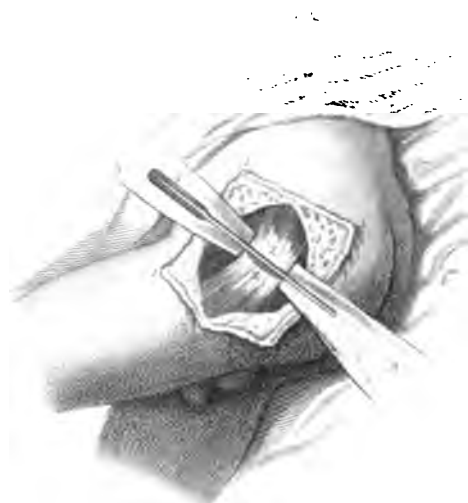
Cases of the second class are much more frequent and more promising.*

Surgical Anatomy.—The hip-joint belongs to the orbicular or ball-and-socket variety. Access to it can be best obtained from the outer side, since the large vessels run in front, the sciatic nerve is behind, and at the inner side we should have to go through a thick mass of tissues, besides the great inconvenience of working in an angle. Normally, the direction of the *cervix femoris* is upward, inward, and a little forward.

Operation.—When no sinuses exist which may be laid open, the surgeon has to choose between several forms of incision.

* See a paper on this subject, by Dr. John Ashhurst, Jr., in the *Pennsylvania Hospital Reports* for 1869.





The one shown in Fig. 2, Pl. XLVI, is a semicircular one, its convexity upward.

Another plan is to make a straight incision from five to seven inches long, just over the trochanter major, parallel with the axis of the femur. Still another is to make an S-shaped cut in the same place.

Whichever method is chosen, the patient is placed on a firm table, etherized, and the affected hip somewhat elevated. The surgeon makes his division of the skin and superficial fascia, and then either works down through the muscles, or cuts them across. Having exposed the joint, and laid it freely open, the head of the femur is tilted out, the soft parts protected by a slip of wood, a bone-director, or a muslin retractor, and the diseased portion of the femur separated by means of a saw. Either the chain-saw or the ordinary one may be used.

The acetabulum, if diseased, is now gouged, or cut away with bone-nippers; if the case is one of gunshot wound, any loose pieces are extracted. Any vessels that spring are carefully secured; and the wound is closed with sutures.

A splint may sometimes be used with advantage to keep the limb steady, for the first few weeks; but in most cases the ordinary weight-extension, as in fractures of the thigh, with sand-bags to give lateral support, will answer every purpose.

Fig. 1, Pl. XLVI, shows the method adopted by Dr. J. R. Barton, in his celebrated case.*

A crucial incision was made over the greater trochanter; the soft parts were dissected up from around the bone, the four flaps, 1, 1, 1, 1, being turned up. Everything being cleared away from the neck of the bone, 2, 2, a retractor, 3, 3, was passed beneath it, and the trochanteric portion almost divided with a strong narrow-bladed saw, 4. By gentle manipulation the remainder of the bone was cautiously broken through, when the limb was brought to its proper line, and put upon a splint with suitable dressings.

If it is decided to attempt the re-establishment of mobility, passive motion should be instituted, at a time to be determined in each case by the judgment of the surgeon. But it would be better to be satisfied with solid union, with the thigh in a favorable posture, than to risk anything in trying to make a new joint.

* See N. Am. Med. and Surg. Journal, vol. iii. pp. 279 and 400. 1827.

Barton's patient is said to have lost his power of moving the limb at the seat of operation, within a few years.

Resection of the femur in its continuity has been done, where the knee was ankylosed in the bent position, in order to enable the patient to walk; a wedge-shaped piece being sawed out, as seen in Fig. 3, Pl. XLVI. (Here the flap has been cut through and turned down, so as to afford a better view.) The mode of doing this needs no further explanation; it may, however, be said that the division should not be completed with the saw, but by gentle extension so as to gradually overcome the resistance of the posterior part of the bone.

After the operation is over, and the limb straightened as nearly as is desired, a trough-shaped posterior splint should be used, to maintain the parts as much as possible at absolute rest until union is accomplished.

Resection of the knee-joint.—This operation may be had recourse to in cases of disease of the knee, where the alternative is amputation. With the question of the choice between these two procedures, we cannot here deal.

Operation.—The patient must be thoroughly etherized, and laid upon his back on a firm table. An incision is then made, either (as in Fig. 4, Pl. XLVI) directly across the joint, on a level with the head of the tibia; or in a curved line with the convexity downward, and terminating on each side just behind the femoral condyles; or by making two lateral incisions united at their lower extremities by a transverse one. Of these methods, unless sinuses exist which may be otherwise followed with advantage, the second is preferable.

The joint being exposed, the crucial ligaments are divided, and the end of the femur tilted out. A thin slip of wood is then placed behind it, and the soft parts held out of the way by means of a retractor, when as much of the bone as is thought needful is sawed off. Any form of saw may be used. Next, the head of the tibia is in like manner removed. The patella is always to be dissected out, as its retention is not only useless but harmful. (In the figure, the femur is represented as sawed through above the limit of the epiphysis; this is especially objectionable in all cases where the bone has not attained its full growth, since the limb will inevitably be much shorter than its fellow, and hence its usefulness in walking will be much lessened.)

After the operation, the limb must be placed on a firm and

well-made splint. An opening may be left opposite the joint, a strong curved iron bar, shaped so as to allow access to the part for dressing, being securely screwed to the upper and lower portions on either side. The wound should be closed with sutures, and dressed with cold or warm water containing a small proportion (about one part to thirty) of carbolic acid.

Resection of the ankle-joint may be required either for injury or for disease.

Operation.—The great object to be aimed at is the avoidance of doing any harm to the tendons, vessels, and nerves in the neighborhood. Almost always this may be accomplished by simply enlarging the sinuses upward and downward, and drawing the soft parts carefully aside.

Fig. 5, Pl. XLVI, shows the removal of the end of the fibula, exposed by a single straight incision, with a gouge and mallet.

Fig. 6 shows the mode of taking away both bones, exposed by two lateral straight incisions. The soft parts are held out of the way anteriorly by a muslin retractor, while those at the posterior part are protected by a slip of wood inserted behind the bones. A narrow bladed-saw is used to make the section, when the ligaments can be readily divided below with the knife so as to complete the operation.

It is better to remove also the upper articulating surface of the astragalus; which may be done by pushing up the foot so as to bring that portion of the bone into the void space left after the lower ends of the tibia and fibula have been cut away. The chain- or narrow saw may then be applied.

Exsection of the *astragalus*, or of other of the tarsal bones, may be required for dislocation or for disease; but no special directions need be given for the procedures, which are usually very simple.

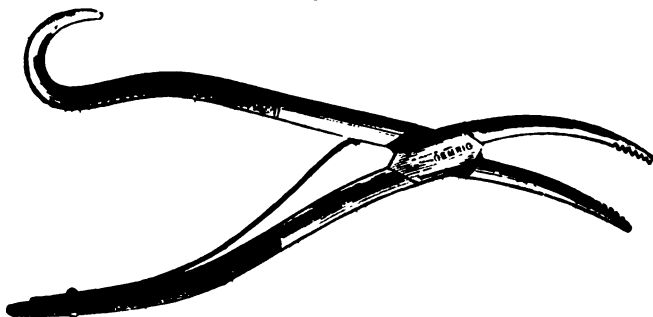
§ III. RESECTIONS IN THE CONTINUITY OF BONES.

These operations, as already mentioned, are sometimes rendered necessary by angular deformity after fractures. Another class of cases requiring them may now be spoken of, viz., those of necrosis or death of part of a bone or bones. This may be due to blows, gunshot wounds, or other violence locally applied, or may occur spontaneously, as for example after typhoid fever. A case of this kind, in which there was exfoliation of several

large pieces of the tibia and fibula of one leg, in a boy eight years of age, was recently under my care at the Episcopal Hospital. The presence of the *sequestrum* or dead portion keeps up a constant irritation, as any other foreign body would, and matter, generally thin and ill-formed, flows through fistulous orifices in the skin. Sometimes these openings are at a distance from the actual seat of trouble, with which they communicate by sinuses, often irregular and tortuous in their course.

As a general rule, resections for necrosis should only be instituted after the necrosed portions are felt to be quite loose; since if violence is used in removing them, the injury done to the adjoining bony structure may cause it also to lose its vitality, or to become inflamed. Sometimes the sequestra are small and accessible, and may be readily picked out by grasping them with forceps, a convenient pattern of which is shown in Fig. 121. Thus in cases of necrosis of the end of a bone

Fig. 121.



after amputation, when the sequestrum has the shape represented in Fig. 122, we have only to wait until the separation is complete, and by getting hold of the end, one blade of the forceps being passed into the central cavity, we can gently extract

Fig. 122.



the dead portion entire. Fergusson's lion-jawed forceps, Fig. 64,* will sometimes prove very useful for this purpose.

* See *ante*, p. 78.

When the necrosed fragment is part of the wall of the bone, even if it be quite long, as in Fig. 123, it may lie superficially, and be readily lifted or coaxed out, perhaps without even enlarging the openings in the skin.

Fig. 123.



But sometimes the sequestrum is surrounded by a deposit of new bone, as in Fig. 124, forming a cavity or *cloaca*, with one or

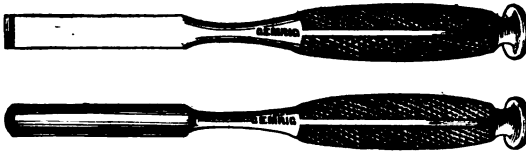
Fig. 124.



more orifices, too small to allow of the extraction of the dead mass.

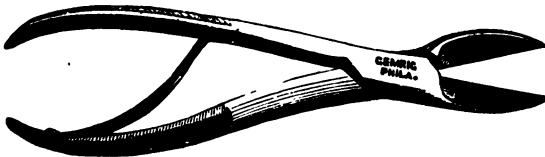
When this is the case, we may sometimes, by means of a

Fig. 125.



chisel, Fig. 125, or cutting-forceps, Fig. 126, enlarge the openings, laying two or more of them in one, until the sequestrum can be removed. Or it may be necessary to make a new opening, by applying the trephine at one or more points, and then using the chisel as before.

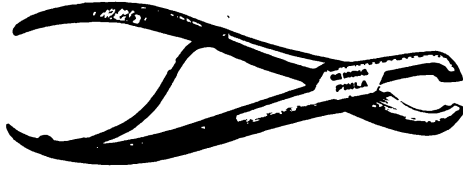
Fig. 126.



In operations of this kind, the gouge-forceps, Fig. 127, are often extremely useful.

After such procedures, the limb is to be placed at entire rest, and cold- or warm-water dressings applied. The cavity left

Fig. 127.



fills up by granulation, the skin contracts and becomes more or less adherent, and after a time the parts are restored in a great degree to their normal state.

Subperiosteal resection.—This plan—taking away diseased or dead bone without removing the periosteum—has of late years been much increased in importance by the researches of Ollier and others on the bone-forming power of that membrane.

General directions for it can scarcely be given. The periosteum should, however, be laid open only to such an extent as may enable us to get an elevator under the diseased bone, or if needful a chain-saw to divide it, when it can be pried or drawn out. My own experience of this plan is limited to one case, in which I removed seven and a quarter inches of diseased tibia; the periosteum closed in and healed by granulation, but no new bone was formed, and I was ultimately obliged to amputate at the knee-joint.

Gouging.—This operation, for the removal of carious bone, has been a favorite one with some surgeons; but it may well be questioned whether the diseased and softened portions would not have been as completely and more safely separated along with the discharges from the wound, without interference.

Should the procedure be determined upon, it may be carried out either with the gouge-forceps or with chisels. The less violence done to the neighboring textures the better. The after-treatment is the same as in cases of necrosis.

CHAPTER XI.

AMPUTATIONS.

THE term amputation is properly applied to cases of removal of portions of the limbs, the bones being divided in their continuity; separation through a joint being called *disarticulation*. Either of these operations may be primary,—performed in cases of injury, before inflammation and suppuration has been set up,—or secondary,—if done at a later stage, or for disease.

There are two modes of amputating: the circular, and the flap. In the circular, which is less in vogue now than formerly, the incisions are all made around the limb in a plane perpendicular to its axis; in the flap method the soft parts are divided so as to make one or more flaps. Obviously, the latter plan may be greatly varied; thus an oval incision may be made, or two lateral flaps, or one anterior and one posterior, may be obtained either by transfixion or by cutting from without inward, etc. *Teale's* method is by a long anterior and a short posterior flap, but rectangular. It is clear that in some cases a greater length of stump may be procured by the flap than by the circular method. Often, in cases of injury with great laceration and bruising of the tissues, we have to get a covering for the bone by saving the soft parts very irregularly.

A method much in favor with some surgeons is to combine the two plans,—making a flap or flaps of the skin, and then dividing the muscles by means of a long knife carried around the limb in one or more circular sweeps.

General Rules.—As much length of the limb should be saved as possible. The nearer the body, the greater the danger; and in these days of artificial substitutes, even a small portion of the forearm or leg may be made very useful.

An ample sufficiency of skin to cover the bone must always be secured. Some surgical writers think that muscular and areolar tissue in a flap are useless, being absorbed; but an examination of many stumps has convinced me that this is an error; it is far better to have plenty of substance.

The incisions should be so made as to bring the cicatrix where it will be subjected to the least possible pressure when the stump comes to be used.

Nerve trunks must be cut off short, and never tied if this can be avoided. .

All bleeding must be completely arrested before the wound is closed.

Appliances.—A good firm operating-table is very important. Few beds are high enough or firm enough. Often a kitchen ironing-table, with a mattress on it, will be available in private cases.

To *prevent* hemorrhage, a tourniquet, or at need a handkerchief twisted with a stick, should be used. It is perhaps more showy, but is certainly more dangerous, to trust to pressure by the fingers of an assistant. (See General Observations, p. 21.)

To *divide the soft parts*, a large scalpel (for fingers and toes a long narrow knife), a set of two or three regular amputating knives, long and heavy, and a narrow double-edged catlin, should be at hand. Fig. 128, *a*, shows the best shape for the single-edged amputating knife, as well as for the catlin, *b*. The

Fig. 128.



handle ought, in every case, to be of such a size as to afford a good grasp to the surgeon.

To *divide the bone*, an ordinary amputating saw of the pattern

Fig. 129.



shown in Fig. 129 is the best. Bow-saws are liked by some surgeons, but are more apt to break. Bone-nippers should be

provided to cut away any splinters left by the giving way of the bone before it is entirely sawed through. (This is sometimes the fault of the assistant who holds the limb.)

To *secure the vessels*, one or two tenacula, artery-forceps, and ligatures, or if preferred, the apparatus for acupressure, will be needed. Styptics are often useful to arrest oozing; or a piece of ice, or a stream of cold water, may be used. Sometimes mere exposure to the air for a few minutes will suffice.

Sutures and needles, adhesive strips, and materials for dressing, sponges, hot and cold water, are of course necessary.

Dressings.—After amputation, the wound is closed by bringing the opposite edges of the skin together. The ends of the ligatures are brought outside, sometimes all at one end of the wound, sometimes in two or more bundles at different points, as the case may be, and a sufficient number of points of the interrupted suture, either silk or metallic, are applied to keep the edges in close apposition. It is always well, and especially in large limbs, where the flaps are heavy, to reinforce the sutures by a sufficient number of adhesive strips, placed at suitable intervals, and long enough to take a firm hold (Fig. 130).

Fig. 130.



When a patient has to be moved soon after the operation, as in military surgery, the stump should be surrounded with a piece of soft old stuff spread with cerate, placed in a bed of charpie or other soft material, and a recurrent bandage (Fig. 131) well applied over all.

Some surgeons, among them Mr. Teale, of Leeds, England, use no dressings, but leave the stump exposed, resting on a

pillow: Simple and non-cumbrous dressings, thoroughly protecting the part from the air, are the best; such as a solution of

Fig. 131.



carbolic acid, one part to from fifteen to thirty of water, applied by saturating an old towel with it, and making of this a triangular cap for the stump, as in Fig. 132.

Fig. 132.

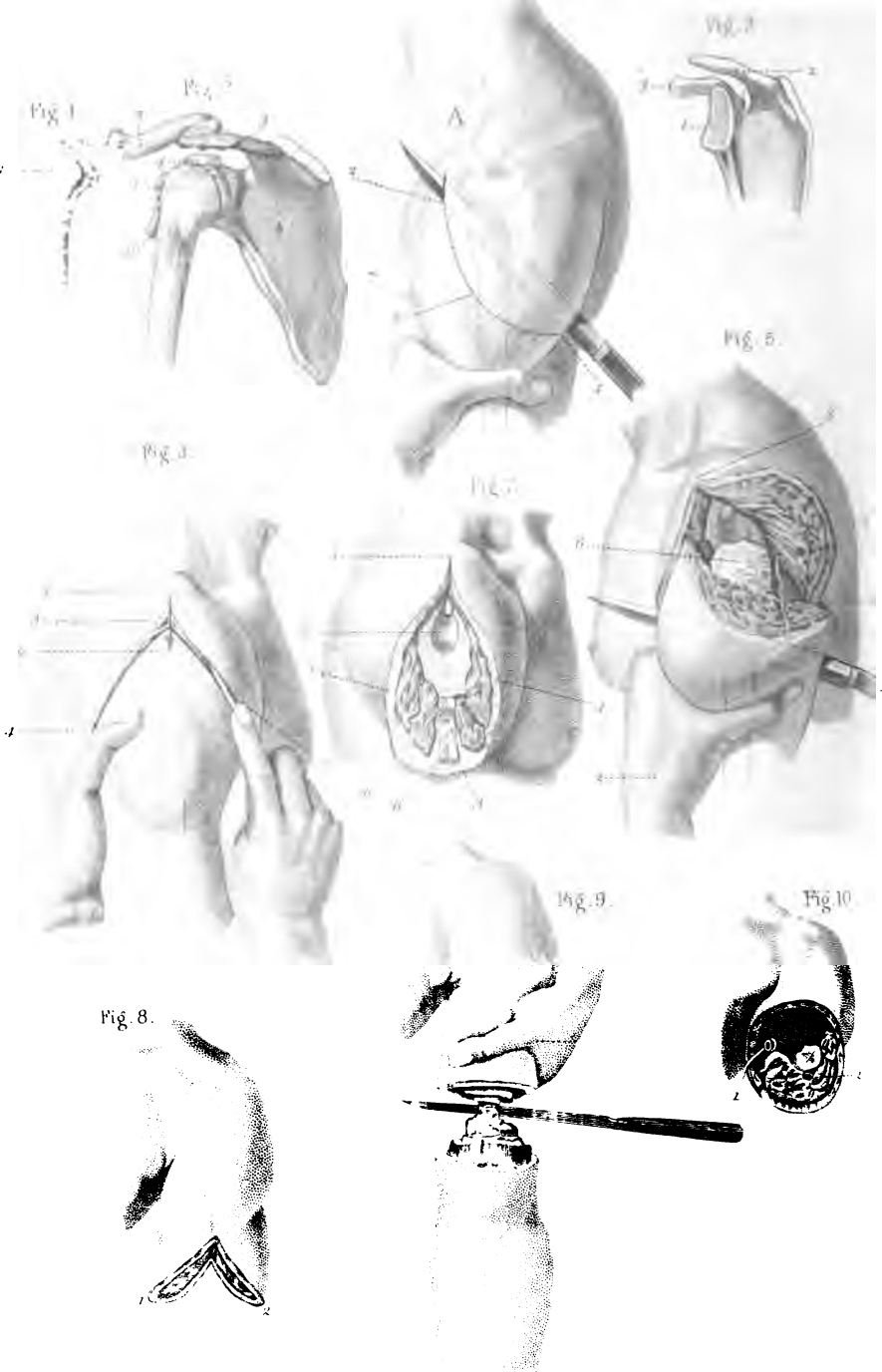


Should no bleeding occur, and the stump remain comfortable, there is no need for removing the dressings for several days, unless they become disordered. An assistant is always needed to carefully raise the stump with both hands while the old dressings, previously loosened, are taken off, and new ones applied.

As soon as suppuration is established, the dressings should be changed daily. Very gentle traction may be made on the smaller ligatures at about the tenth day, should they not come away earlier of themselves.

With the dangers of these cases—pyæmia, sloughing, tetanus,

Fig. 4



osteo-myelitis, necrosis, deformity of stump, neuralgia—we cannot now concern ourselves. Secondary hemorrhage ought not to occur; when it does, good surgery demands the opening of the stump and the securing of the bleeding vessel.

§I. AMPUTATIONS OF THE UPPER EXTREMITY.

Amputation (disarticulation) at the shoulder-joint.—

Formidable as it is in appearance, the statistics of this operation are encouraging. To do it well requires a knowledge of the

Surgical Anatomy.—The head of the humerus is spheroidal, and much larger than the shaft, to which it is set on at an angle. Fig. 1 shows the upper part of the bone in its outer and somewhat posterior aspect, 1 being the greater tuberosity.

Fig. 2 shows the bone in its relation with the scapula and clavicle. 1, the head of the humerus; 2, the clavicle; 3, the acromion process; 4, the coracoid process, and 5, the dorsum, of the scapula; 6, the long tendinous head of the biceps muscle, cut off.

Fig. 3 shows the upper part of the scapula, the humerus removed. 1, the glenoid cavity, very small in comparison with the head of the humerus; 2, the acromion process, and 3, the coracoid. The acromion projects out over the glenoid cavity, curving sharply forward to articulate with the clavicle; the coracoid runs out just above and in front, and then turns outward.

Hemorrhage is to be prevented by pressure, made either with the fingers of an assistant, or with the wrapped handle of a door-key, upon the subclavian as it passes over the first rib. A, Fig. 4, Pl. XLVII, will show about where this pressure should come.

In all the methods of operating, the portion of the flap containing the artery is cut *last*, and the surgeon or an assistant instantly grasps and secures the vessel.

Operation.—Lisfranc's method, by transfixion, is shown in Figs. 4 and 5, Pl. XLVII.

On the left side, the surgeon standing on the outer side of the limb, the transfixion is made from the posterior fold of the axilla to close to the acromion, the knife just grazing the humerus. The knife having cut its way out, and the flap thus made, 2, 3, 4, being raised, the joint is opened, the head of the bone tilted outward, the knife passed behind it, and the other flap made as in Fig. 5. 3, 4, 5, the first flap. 6, head of bone. On the right side, the transfixion for the posterior flap is in like manner

made first, but the surgeon stands at the inner side, and the knife goes from close to the acromion backward to the fold of the axilla.

Larrey's operation is perhaps the one of all others which has given the best results; it is less brilliant than Lisfranc's, but safer.

The surgeon, standing behind the left shoulder, or in front of the right, makes an incision about two inches long from the tip of the acromion process, in a direction parallel with the fibres of the deltoid, 1, 2, Fig. 6; from the lower end of this he next carries one curved incision, 2, 3, to the anterior, and another, 2, 4, to the posterior fold of the axilla, each enclosing a semilunar flap. The muscular tissue being correspondingly divided, and the head of the bone turned out, there remain only the axillary structures to be cut across, and before this is done the vessels may be controlled by grasping them between the finger and thumb.

Fig. 7, Pl. XLVII, shows the flaps as made in this operation; 1, 2, 3, the posterior. 1, 4, 3, the anterior. 5, the glenoid cavity; 6, 6, the vessels.

Still another method, and one which affords some advantages, is to make a deltoid flap, open the joint, turn out the head of the humerus, and then finish the axillary or lower flap as in the plan last mentioned.

The smaller vessels, the supra- and subscapular and the two circumflex arteries, should be at once tied, with any others that may spring, after the axillary has been secured.

Amputation of the arm.—This is one of the simplest and easiest operations in surgery. Fig. 8, Pl. XLVII, shows an internal flap, 1, and an external one, 2; these may be made either by transfixion, or by cutting down toward the bone.

Fig. 9 shows the circular method, the skin being drawn upward after division, and the muscles cut by successive circular sweeps with the knife.

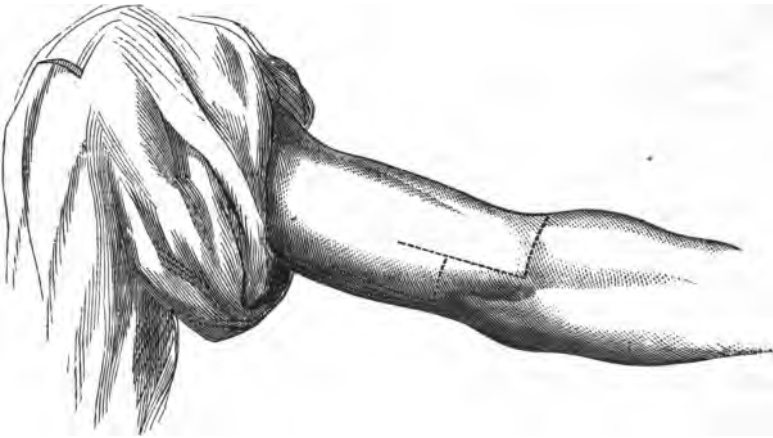
A tourniquet should in either case be used to prevent the loss of blood.

Fig. 10 shows the face of the stump just above the middle of the arm. 1, the brachial artery; 2, the profunda.

It is in the arm and thigh that the want of bulk in the flaps is most likely to give trouble; that unpleasant result, a conical stump, being very apt to occur here.

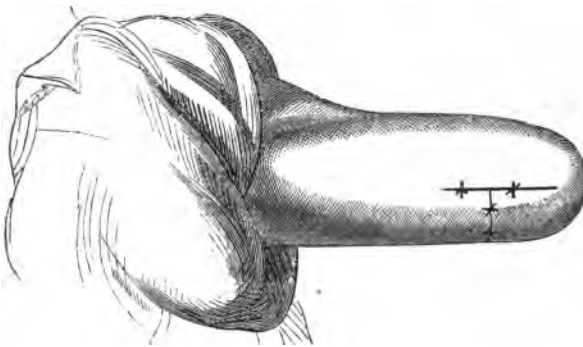
Fig. 133 shows Teale's method as applied to the arm; the long flap being one-half the length of the circumference of the

Fig. 133.



limb, and the short flap one-eighth. Fig. 134 shows how these flaps come together. They may be united by wire sutures, and the stump either dressed in the ordinary method, with cold or

Fig. 134.



warm water, or left exposed to the air, resting on a pillow, as advised by Teale. My own preference is for dressing with a weak solution of carbolic acid (one part to thirty of water).

Amputation (disarticulation) at the elbow.—This operation is not often done.

Surgical Anatomy.—The bones entering into the composition of the elbow-joint are: the humerus, 1, the radius, 2, and the ulna, 3 (Pl. XLVIII, Fig. 1).

In Fig. 2 they are seen from the inner side.

Fig. 3 shows the joint in its anterior aspect. 1, the humerus; 2, the radius; 3, the ulna; 4, 5, the lower margins of the condyles of the humerus; 6, 7, the line of the articulation.

Operation.—This may be done by either the circular or the flap method.

(1) The *circular* method. The surgeon, standing on the inner side for the right, and on the outer side for the left arm, grasps the forearm with his left hand, and makes a circular cut through the skin and fascia about four fingers'-breadths below the condyles of the humerus, the elbow being flexed at a right angle. Drawing the divided tissues well up, he now carries the knife around in the same manner down to the bone. By a third cut the biceps tendon, brachialis anticus muscle, and ligaments of the joint are divided. Lastly, either the olecranon is sawed through at its base, or its fibrous attachments to the humerus are cut through.

The rest of the operation,—the securing of the vessels, etc., is done as usual. Fig. 6, Pl. XLVIII, represents this procedure, except that the skin-flap is, as advised by Velpeau, turned up like a cuff, 1, 2. It is better to merely retract it, as above directed.

(2) The *flap* method. Standing on the inner side of the limb, the surgeon directs an assistant to supinate the hand and to flex the elbow to about 135°. Grasping the tissues in front of the joint with his left hand, he now enters a narrow double-edged knife, about an inch below the inner condyle of the humerus, and pushes it across, grazing the bones, so as to make the point emerge about two inches below the outer condyle. The tissues thus transfixed, the knife is made to cut its way out, so as to form a flap about three inches in length. Next, the posterior division is made across the base of the olecranon, the anterior flap raised, the joint opened in front, the ligaments and the triceps tendon cut, and the operation is complete.

The dressing of the stump thus made is done in the usual way. Fig. 7 shows the open wound, the brachial artery, ligated, in the anterior flap.

Amputation through the forearm.—This may be done

(1) by the *circular* method, as shown in Figs. 8 and 9, Pl.

Fig. 2.



Fig. 1.



Fig. 3.



Fig. 4.

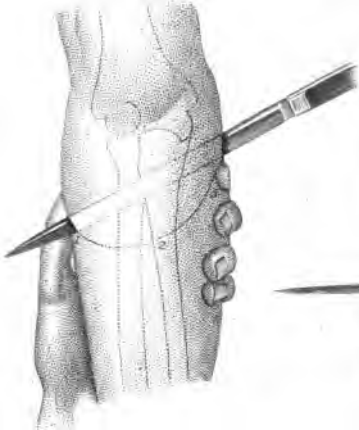


Fig. 5.

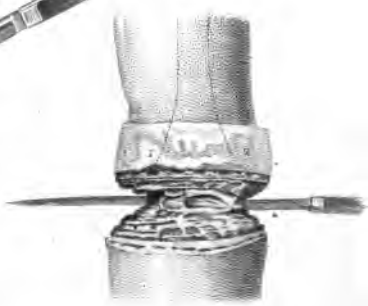


Fig. 6.

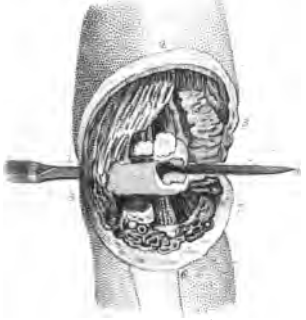


Fig. 8.



Fig. 7.



Fig. 9.

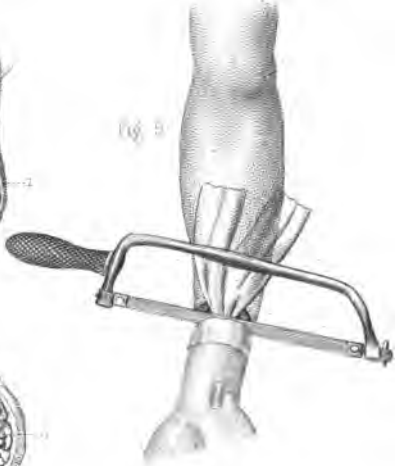
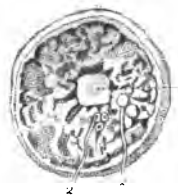


Fig. 10.





XLVIII. The surgeon may stand on the outer side of the right limb, and on the inner side of the left, so as to have his own left hand to turn back the skin. In Fig. 8, the hand of an assistant, 1, is seen also drawing up the skin of the member. After the skin is turned back sufficiently, the soft parts being divided down to the bones, a retractor of three tails is applied (the middle tail being passed between the bones), and the saw is used. Care must be taken to apply the saw accurately to both bones at the same time, as is shown in Fig. 9.

Usually, at least three vessels have to be secured.

(2) The *flap* method. Generally speaking, it is better to make a long posterior flap, and a short anterior one. Teale's plan answers very well here; I have several times, in my own practice as well as in that of other surgeons, seen complete healing of such stumps within twenty days. Here, as in the leg, in making the incisions, the long flap should be somewhat wider than the short one.

The hand being semiprone (the thumb upward), the surgeon stands on the inner side of the left limb and on the outer side of the right, and with either a large scalpel or a small amputating knife makes an incision from three to five inches long (according to the size of the limb), parallel with the palmar edge of the radius and about half an inch from it. Next, carrying the knife transversely across the back of the limb, the outline of the flap is completed by a similar incision parallel to the ulna and about half an inch from its palmar edge. This flap is now dissected up from the bone, so as to contain all the muscular tissue (not tendons) available; and then the short flap is made, beginning at about an inch from the point where the knife was first entered, and curving almost directly across to a corresponding point at the ulnar side, the tissues being dissected up as before. The corners of these flaps are rounded, not rectangular as in Teale's method. Both flaps are now retracted, the bones entirely cleared of soft parts, interosseous membrane, etc., and the saw applied. The remainder of the operation is done as in other cases.

When amputation is done low down in the forearm, it is of great importance to make the flaps of skin alone, drawing out the tendons, and cutting them off as short as possible.

Amputation (disarticulation) at the wrist-joint.—This operation is sometimes required for injury, but more commonly

for disease, of the hand. It may be done either by the circular or by the flap method.

Surgical Anatomy.—The lower extremities of the radius and ulna (1, 2, Fig. 1, Pl. XLIX), with the intervening cartilage, form a somewhat crescentic depression, into which is received the upper row, 3, of carpal bones. With the latter are joined the second row, 4, of carpal bones, and with these again the metacarpals, 5. The mobility of the wrist belongs exclusively to the radio-carpal articulation, and it is through this joint that the operation is best done, as the small bones of the wrist are very apt to become necrosed if left.

Operation.—(1) *Circular.* (Fig. 2, Pl. XLIX.) The vessels being commanded by a tourniquet over the brachial, a small amputating knife is swept around the base of the hand, a full inch below the styloid process of the radius; the skin and superficial fascia being thus divided, are dissected up and turned back. The hand being drawn into adduction, the joint is opened from the radial side, the dorsal tendons and ligaments made tense and divided, the ulnar lateral ligament cut through, and the palmar tendons drawn down so as to cut them as high up as possible. The vessels are then secured and the wound dressed.

(2) *Flap.* A slightly curved incision, its convexity downward, is to be made from close to the tip of one styloid process to the other, over the back of the wrist. The joint is now opened, and the lateral ligaments divided; when by flexing the hand strongly, the knife may be passed between the radius and the first row of carpal bones, and the palmar fibrous tissues cut through. The palmar flap is now marked out and dissected up, full two inches in length, and well rounded at the corners; it should consist of skin and superficial fascia only.

This flap may, by an expert operator, be cut from within outward, as represented in Fig 3; but care must be taken lest the irregularities of thickness in the palm give rise to defects in its shape. The flaps should present the appearance shown in Fig. 4.

Amputation (disarticulation) of the metacarpus.—Sometimes, in cases of injury especially, it is highly desirable to save the thumb, although the rest of the hand must be sacrificed.

Operation.—The hand being strongly supinated, a narrow double-edged knife is inserted a little below the joint between the unciform bone and the fifth metacarpal, passed across the palm close to the bones, and made to emerge just below the

Fig 1



Fig 2

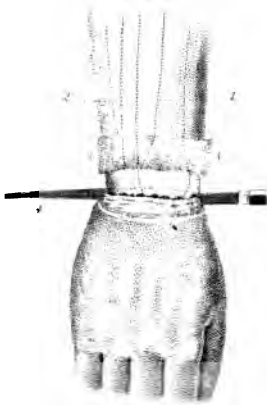


Fig 3



Fig 4



Fig 5



Fig 6



Fig 7

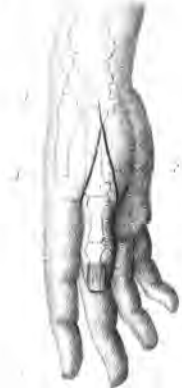
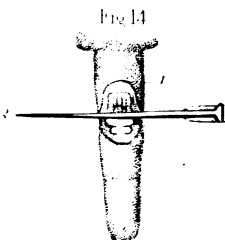
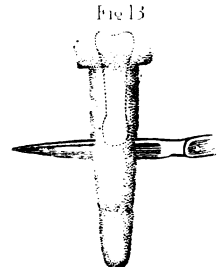
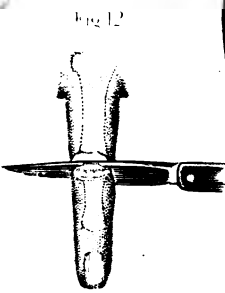
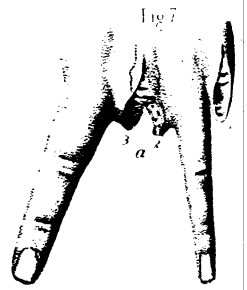
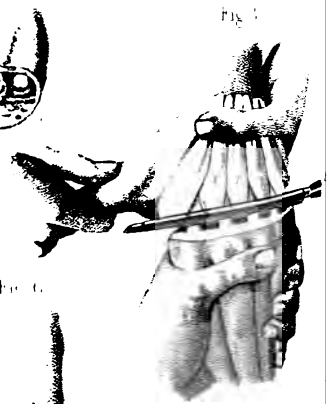


Fig 8



Fig 9





joint between the trapezium and the second metacarpal. It is now carried downward parallel with the bones, and made to cut its way out, forming a large elliptical palmar flap, Fig. 5, Pl. XLIX. Next, the hand being strongly pronated, a semilunar incision is made across the back of the hand, as in Fig. 6, about one inch below the carpo-metacarpal joint; and this flap being dissected up and turned back, the fibrous attachments of the metacarpus are all divided.

Disarticulation of the thumb.—In Fig. 7, Pl. XLIX, the line of incision is shown, beginning near the upper end of the metacarpal bone, and sweeping round in an oval direction so as to come just below the metacarpo-phalangeal joint. The soft parts of the angle of the wound so made are dissected up, and the head of the metacarpal bone turned out as in Fig. 8; when by following it along closely, it may be altogether removed, with the thumb. Fig. 9 shows the wound as closed.

Amputations of the fingers.—These operations are all the more difficult on account of the small size of the parts.

(1) **Disarticulation of all the fingers at the metacarpo-phalangeal joints.**

Anatomy.—The main point to be borne in mind is the relation between the heads of the metacarpal bones and the soft parts of which the flaps are to be made, viz.: that the line of the joints is about one inch above that of the webs between the fingers.

Operation.—The hand is steadied in the prone position, and the thumb held out of the way, by an assistant; the surgeon makes a semilunar dorsal incision, beginning outside of the metacarpo-phalangeal joint of the little finger in the right hand, or of the forefinger in the left, and going close to the roots of the fingers. Dissecting up the skin and superficial fascia, as far as the joints, he next divides the extensor tendons, flexes the fingers strongly, opens each joint, and by touches of the knife divides all the lateral ligaments. Now, getting the blade of the knife, as in Fig. 1, Pl. L, across the line of the joints, he turns its edge forward, and makes it cut its way out so as to form the longest possible flap from the palmar tissues. Fig. 2 shows the wound thus made, 1, 2, 3, being the palmar flap.

(2) **Amputation through the metacarpus** is done much in the same way, except that both flaps are first dissected up,

and then, a five-tailed muslin retractor being applied to protect the soft parts, the saw is carried evenly across the bones so as to divide them all at the same time. Fig. 3, Pl. L, shows this process.

(3) **Amputation of the little finger** is shown in Figs. 4, 5, and 6, Pl. L. It is much like that of the thumb, before described. Fig. 4 shows the incision, along the metacarpal bone and around the base of the finger. The soft parts being stripped up, and retracted, the bone is sawed or nipped off, as in Fig. 5 (where, however, it is too long). Fig. 6 shows the line of the wound as closed.

(4) **Amputation (disarticulation) of one finger** may be done by a double flap or by an oval method. The former is shown in Pl. L, Fig. 7, *a*. The adjacent fingers being held aside, the surgeon carries an incision from over the head of the metacarpal bone downward, around the side of the finger to its palmar surface, and thence to a point corresponding to the one above. A second incision begins at the first about three-quarters of an inch from its commencement, passes around the other side of the finger, and falls into the first about three-quarters of an inch from its termination. The flaps thus described are dissected up, the joint exposed, and its fibrous surroundings divided.

Oval method. This is begun as in the manner just described; but when the knife reaches the side of the finger it is swept directly round its palmar surface, up on the other side, and backward on the dorsum to about half an inch from its point of commencement (Pl. L, Fig. 7, *b*).

(5) **Disarticulation of Phalanges.**

Surgical Anatomy.—Fig. 8, Pl. L, shows the shape of the different articulating ends of the bones. 1, the metacarpal, 2, the first phalanx, 3, the second, 4, the third.

Fig. 9 shows the relations of the flexor tendons; 1, 1, 1, the joints, 2, the flexor perforatus, going to the second phalanx, 3, the flexor perforans, going to the third.

Fig. 10 shows the relations of the soft parts to the bones in extreme flexion of the fingers.

Operation.—Usually a long flap is taken on the palmar surface of the finger, by the plan shown in Figs. 11, 12. The finger is somewhat flexed, and the joint opened on the dorsum, as in Fig 11, then, the head of the phalanx being tilted up, the

knife is turned as in Fig. 12, keeping it very close to the bone, and made to cut a long flap, as broad as possible, from the palmar soft parts.

Figs. 13, 14, Pl. L, show the reverse method of doing this. In Fig. 13 a narrow knife has been pushed through in front of the joint, to cut its way out and make the palmar flap; this latter being then reflected upward, as in Fig. 14, the joint is opened and the dorsal soft parts divided.

Figs. 15 and 16, Pl. L, show the flaps obtained in these operations. Fig. 17, the mode of closing them.

§ II. AMPUTATIONS IN THE LOWER EXTREMITY.

Amputation (disarticulation) at the hip-joint.—This very formidable operation has been so many times done with success in this country, as well as abroad, that it cannot but be regarded as among the legitimate resources of surgery, although the chances should be well weighed before it is decided upon.

As performed for injury, it has been far less successful than as performed for disease. As a reamputation (part of the limb having been removed before) it is deprived of much of its risk.

The chief danger is from shock, from the loss of so large a portion of the frame. Another, much more preventable, is that from loss of blood.

The patient should be abundantly but not excessively stimulated beforehand.

At the time of the operation, brandy, carbonate of ammonia (suspended in sweetened mucilage, gr. xx to fʒss), and other stimulants, should be at hand.

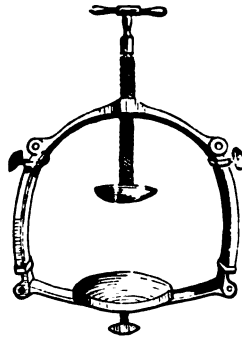
The temperature of the operating-room should not be below 75° Fahrenheit.

One assistant, thoroughly skilled and to be depended upon, should take charge solely of the *control of the bleeding* (not of tying the vessels). If the aortic compressor (to be presently described) is used, he should adjust and regulate this; if not, he should compress the femoral artery against the brim of the pelvis, just below Poupart's ligament, and have no other thought or duty. Either the finger, or the handle of a large door-key, well wrapped, may be used to make the pressure.

Another assistant should be ready to secure and tie the vessels as soon as the flaps are made. The aortic compressor (rep-

resented on a small scale in Fig. 135) is composed of a padded plate, to be placed at the back of the patient, and upon which

Fig. 135.



he lies. To this are attached two upright bars, with a sliding portion on each, fixed at any desired height by a small screw.

Passing across between the upper ends of these sliding portions is a bar, carrying an upright screw, with at its lower end a plate suitably padded. (This should be so arranged as to be moved only up or down, but not rotated, when the screw is turned.)

When properly applied, the lower pad is under the loins of the patient, and the upper one compresses the aorta against the bodies of the vertebræ, a little to the left of the median line; the mass of the intestines being pushed carefully over toward the right before the screw is turned and the pressure made, lest they be bruised by it.

Surgical Anatomy.—Pl. LI, Fig. 1. The femoral artery passes out from beneath Poupart's ligament, just in front of the joint. About two inches below its point of exit, it gives off the profunda. The direction and shape of the neck of the femur, its relation to the trochanters, and the form of the acetabulum, must be familiar to the surgeon by study on the dead body, if he would operate confidently, rapidly, and safely.

A branch of the internal iliac artery (which is therefore not controlled by pressure in the groin) accompanies the sciatic nerve. This, when aortic compression is not resorted to, must be secured as soon as possible after the incisions are completed.

Operation.—The surgeon stands on the outer side for either limb. The patient is brought to the very edge of a firm operating-table, his nates just clearing it.

Fig. 1.

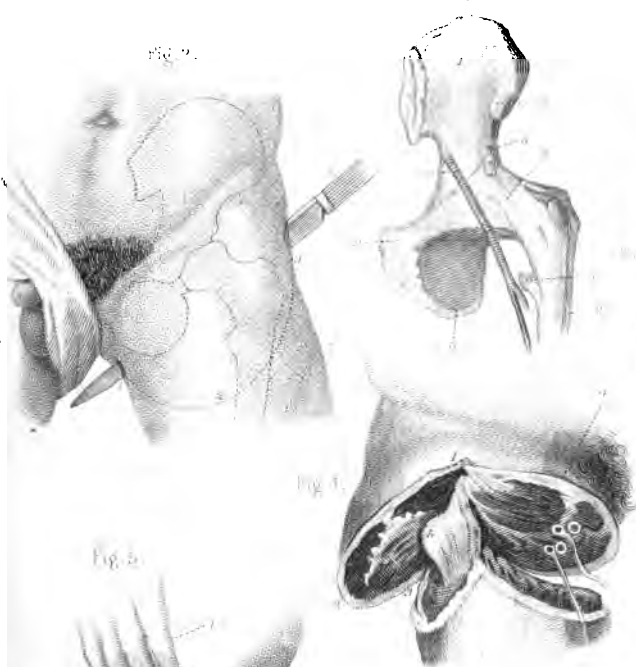


Fig. 3.

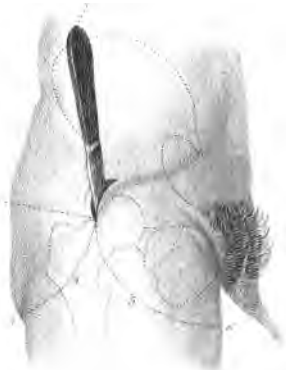


Fig. 4.



Fig. 5.

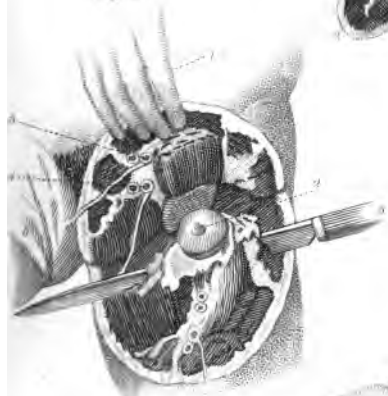


Fig. 6.

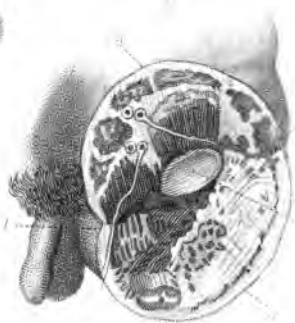
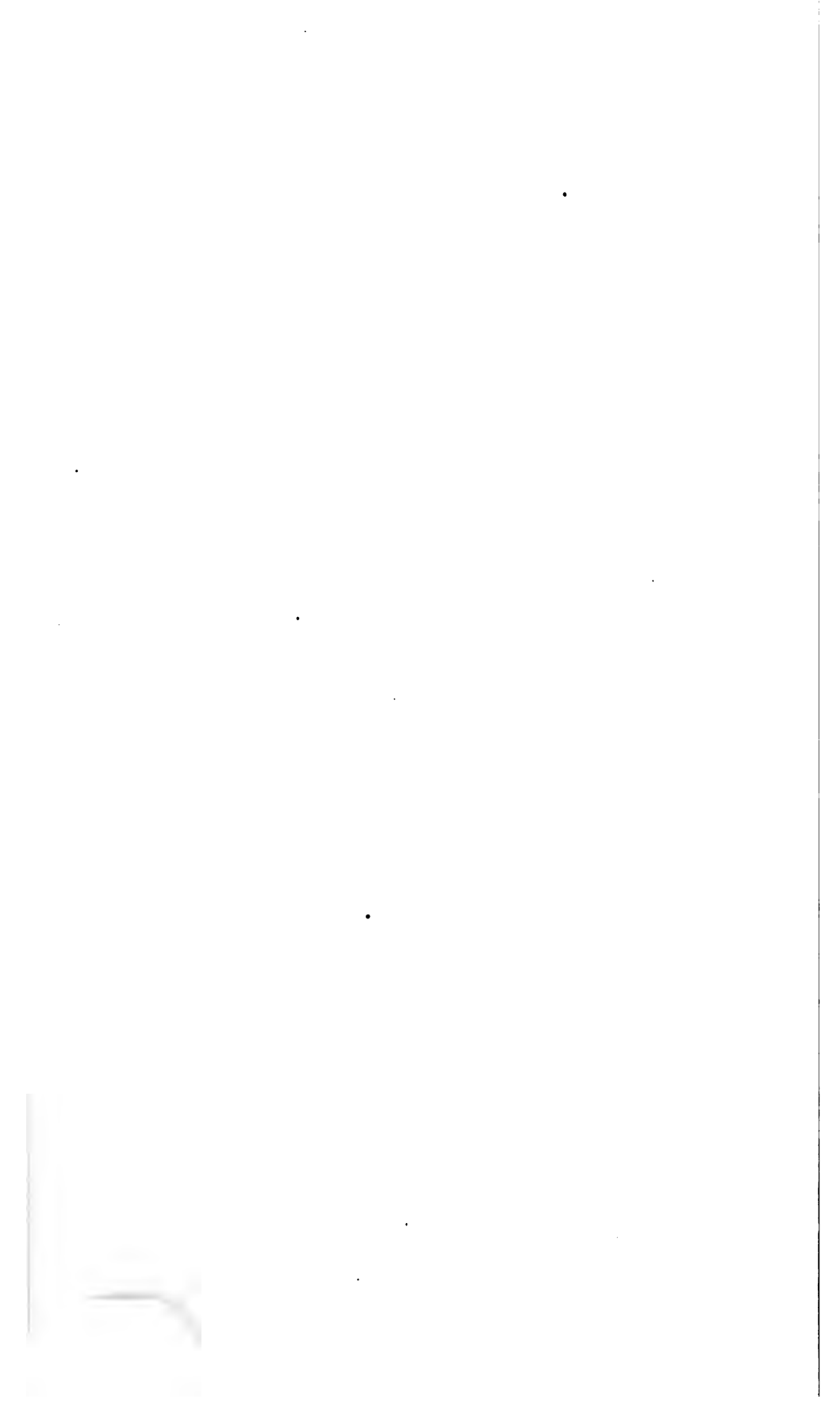


Fig. 7.





Six reliable assistants are indispensable. One keeps the sound limb aside out of the way; he may also keep the genital organs well supported. One manages the limb to be removed. One controls the flow of blood, as before mentioned. Another sponges the wound, and secures the divided vessels, which it is better the surgeon himself should tie. One, accurately instructed as to the proposed steps of the operation, hands the instruments. One administers the anæsthetic and watches the pulse and respiration; he should be so experienced as to require no directions.

The operation may be done in various ways. In very thin subjects, the soft parts may be divided by cutting from without inward, down to the bone; but when there is any mass of muscular tissue, the "flap method by transfixion" is by far the best. Three forms will be described here: by antero-posterior flaps, by lateral flaps, and by a long anterior and short posterior flap (Van Buren's).

(1) By *anterior and posterior flaps*. The limb being slightly rotated inward, and flexed somewhat, the tip of the long double-edged knife is entered a little above the greater trochanter, on a line with its posterior margin, and carried across the front of the joint, close to the bone, then slightly pushed backward, and brought out in the perineal fold, a little in front of the tuber ischii (Pl. LI, Fig. 2, 1). It is now carried downward, along the femur, and then turned gradually upward, so as to cut a flap from five to eight inches long, according to the size of the limb.*

If the vessels are not perfectly controlled, the femoral artery will now bleed, and must be instantly grasped in the flap, secured, and tied.

The posterior flap is next made: the femur is drawn downward, so that the capsular and round ligaments may be readily divided, when the long knife is inserted behind the head of the bone, as in Fig. 5, so as, beginning about one inch below the line of the first transfixion, to make it cut its way out as before; here also forming a flap from five to eight inches in length.

Fig. 6, Pl. LI, shows the completed section, with the vessels

* Nothing but practice on the dead subject will give the knack of doing this. It is the same movement, but on a larger scale, as in the flap amputation of the arm.

ligated. 1, 3, the line of junction of the flaps; 2, the upper flap, 4, the lower; 5, the acetabulum.

(2) By *lateral flaps*. The outer flap is the one first made. The surgeon, determining the position of the head of the femur, passes in the long knife just over it; but by inclining the handle inward, he makes the blade just graze the outer side of the neck of the femur, grasping the tissues while an assistant abducts the limb, and bringing the point out a little below the tuber ischii. Clearing the greater trochanter, the knife is now made to cut a flap about eight inches long (2, 3, 4, Fig. 3, Pl. LI).

Next, by adducting the knee, the assistant holding the limb puts the capsular ligament on the stretch, when the surgeon divides it, inserts the knife behind the head of the bone, and cuts the inner flap about six inches long (2, 5, 6, Fig. 3, Pl. LI), beginning an inch below the line of commencement of the outer flap. As soon as possible the vessels are secured. Fig. 4 shows this stump, as made by some operators, the flaps being both made first, and then the disarticulation accomplished.

(3) *Van Buren's method*, represented in Fig. 7, is a very excellent one. The anterior flap having been formed by transfixion, as in the method first described, is forcibly drawn upward by an assistant. "The surgeon then, slightly kneeling, carries the knife beneath the thigh to its inner side, as in a circular amputation, and placing its heel on the integuments at the internal angle of the wound, sweeps it firmly across through the tissues on the back part of the thigh, cutting with a slightly sawing motion down to the bone, and joining the two extremities of the first incision. The long knife is then immediately relinquished, and with a large straight scalpel, the femur being forcibly abducted, the capsule of the joint is laid open as near as possible to the acetabulum, the round ligament divided with the rotator muscles inserted into the trochanter, and the fossa at its base, the assistant managing the limb so as to keep these parts successively on the stretch, and the operation is completed."*

Fig. 7, Pl. LI, exhibits this method, which is almost exactly the same that I myself used in a successful reamputation in

* Trans. New York Academy of Medicine, vol. i. Also "Contributions to Practical Surgery," by W. H. Van Buren, M.D., Phila., 1865, p. 9.

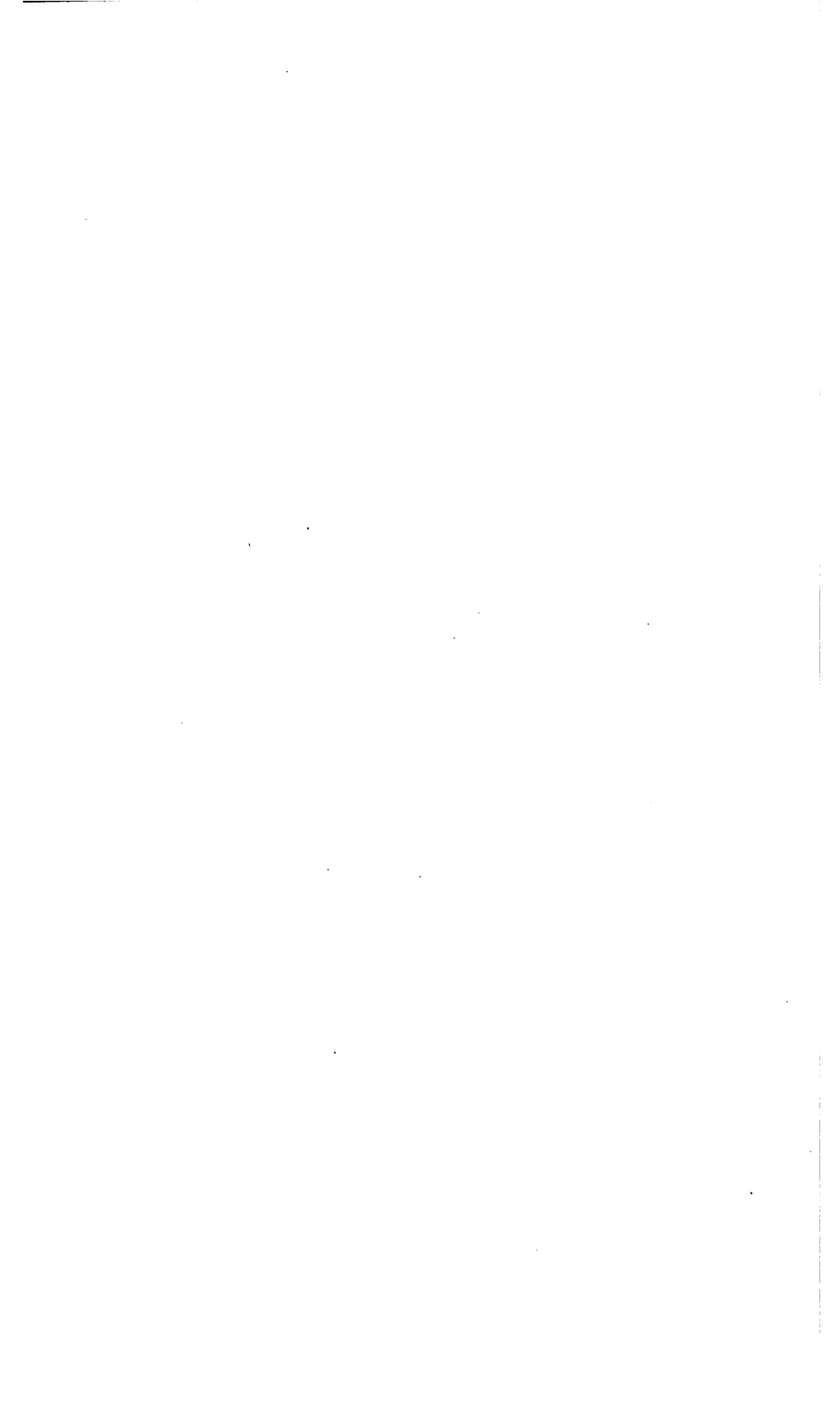


Plate LII

Fig 1.



Fig 2.

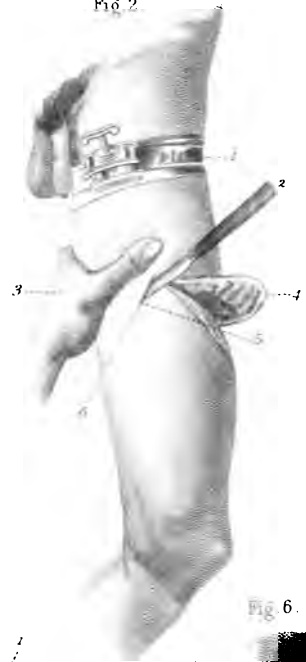


Fig 4.



Fig 3.



Fig 6.



Fig 7.

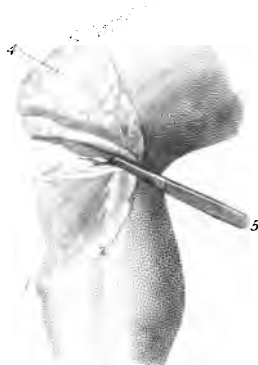
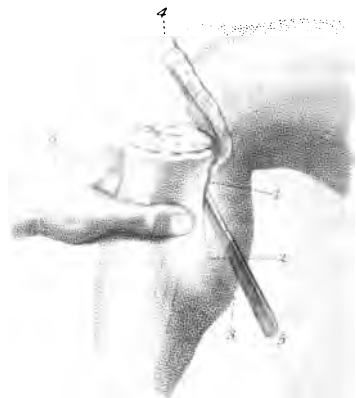


Fig 5.



1864,* and which I have since seen employed by others. 1, the surgeon's right hand, carrying the knife, 2, to the inner side of the thigh. 3, left hand of the surgeon, 4, 4, hands of an assistant pulling the anterior flap upward. 5, 5, hands of an assistant keeping the sound limb and the genitals out of the way. 6, edge of wound.

Amputation of the thigh.—The circular method is very simple, but the cicatrix comes over the end of the bone. Fig. 1, Pl. LII, shows the knife being swept around the limb so as to make the division of the muscles, the skin being turned up, and the left hand of the surgeon not only steadying the limb, but drawing up the skin. 4, 4, the lower edge of the divided skin. (By making this cut somewhat angularly, as in the figure, the turning up is very much facilitated.) 3, hand of an assistant compressing the artery in the groin; it is much better to use the tourniquet.

In Fig. 3 the sawing of the bone is shown, a retractor, 1, being applied so as to keep the soft parts out of the way.

Fig. 2, Pl. LII, represents the flap operation. The tourniquet, 1, being applied, an anterior flap, 4, has been made by transfixion, and turned backward. Next, grasping the soft parts behind the bone with the left hand, 3, the operator pushes the catlin, 2, through them, and cuts the posterior flap as far as 6.

It is much better to make the anterior flap considerably longer than the posterior. This greatly favors the escape of the discharges, and brings the cicatrix at a more convenient point.

Perhaps a still better method is to make skin flaps, a long one anteriorly, a short one posteriorly; and then, turning both these up out of the way, to divide the muscles circularly.

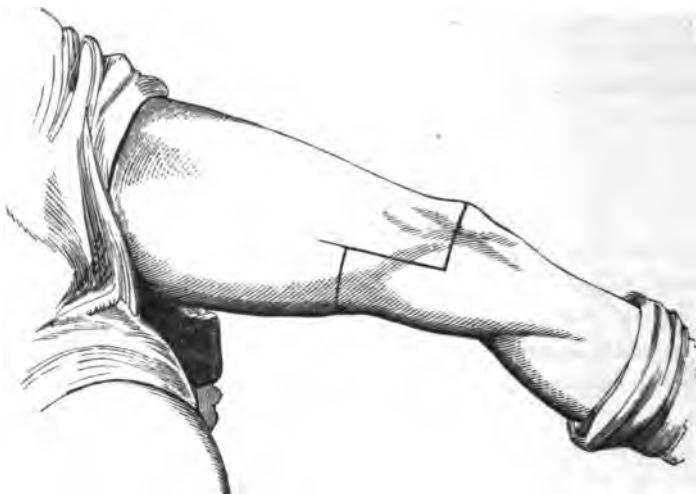
The only objection to making the long anterior flap in either of these methods is that it makes the division of the bone come at a higher point than if the two flaps are made of the same length; and this is perhaps set aside by the advantages above mentioned.

Teale's *rectangular* method answers extremely well in the thigh. The same rule holds here as in other situations, viz., to make the anterior flap of a length equal to one-half the circum-

* New York Medical Journal, Dec. 1865.

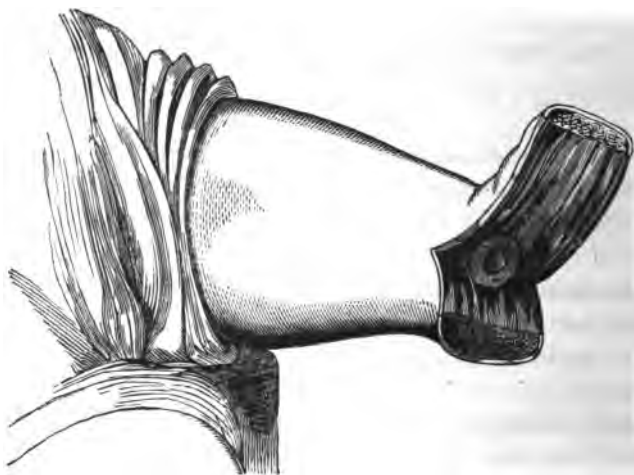
ference of the limb, and of the same width ; and the posterior one-quarter as long as the anterior, Fig. 136. Thus, if the thigh

Fig. 136.



is sixteen inches in circumference, the anterior flap will be eight inches long and eight wide, and the posterior, two inches

Fig. 137.

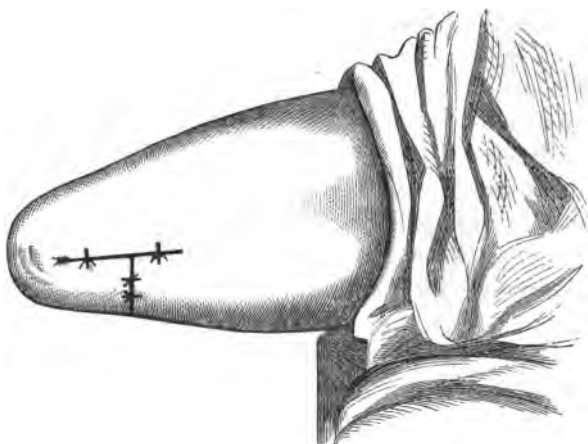


long and eight wide. In tracing the lines for the flaps, as Teale advises to be done, the inner line should be drawn

anterior to that of the vessels, which will thus be in the short or posterior flap.

Both flaps are dissected up close to the bone, which is then sawn through at the line of their junction, as in Fig. 137. When closed, the stump will present the appearance shown in Fig. 138.

Fig. 138.



Amputation (disarticulation) at the knee-joint.—This operation, in many cases a most valuable one, has gained strong advocates within the last few years.*

Surgical Anatomy.—The knee-joint is the largest in the body, and is composed of the femur with its condyles, received into the two depressions at the upper end of the tibia; the patella lying in front. Besides the capsular ligament, these two bones are held together by the ligament of the patella, or tendon of the quadriceps, in front, by the hamstring muscles, inner and outer, and by the heads of the gastrocnemii, posteriorly, and by the two crucial ligaments within the joint. Close behind the articulation lies the artery, with the vein and nerve.

Operation.—This may be done, like that at the elbow, by the circular method; but the flap is preferable. A long and short flap are generally made; and there are two plans, according as the long flap is anterior or posterior. The latter will be first described, although, when circumstances will admit, the other is better.

* See an excellent paper by Dr. Brinton, of Philadelphia, in the American Journal of the Med. Sciences for April, 1868. Drs. Markoe and Stephen Smith, of New York, have also advocated it.

(1) *Long posterior flap.* The knee being straight, an incision is made as in Pl. LII, Fig. 4, 1, 2, 3, beginning on one side of the joint, curving round just above the tubercle of the tibia, and ending opposite its point of commencement. Everything being divided down to the bone, the ligament of the patella is cut, and the soft parts reflected, opening the joint. The crucial ligaments are cut through, and the knee flexed to a right angle. Next, grasping the bones so as to push back the relaxed muscles of the calf (Fig. 5), the surgeon carries the amputating knife back of the head of the tibia, and cuts downward so as to make a wide flap at least six inches long.

The disadvantage of this method is that secondary hemorrhage is apt to occur from the muscular arteries in the long flap.

(2) *Long anterior flap.* The knee being flexed at a right angle, the surgeon describes with a scalpel an incision, beginning well behind the condyle of the femur, passing downward, and curving across the front of the leg an inch or more below the tubercle of the tibia. This flap being dissected up, the ligament of the patella is cut close to that bone, the joint opened, and the crucial ligaments divided. An amputating knife is now passed between the femur and tibia, and made to cut almost directly backward, thus forming a posterior flap of very small dimensions (Fig. 7).

The advantages of this method are: (1) that secondary hemorrhage is not likely to occur; (2) that there is a ready exit for discharges; (3) that the cicatrix is so placed as to be out of the way of pressure when the stump comes to be used.

The *circular* method alluded to is shown in Pl. LII, Fig. 6; it is at present wholly superseded by the flap.

Amputation of the leg.—This operation may be rendered necessary either by disease or by injury. It may be done at any point, as low down as circumstances will permit; in the old days of wooden legs the rule was to amputate high up, since a long stump, projecting backward, would be constantly in the way.

Various methods may be adopted, according to the amount of involvement of the soft parts. Sometimes the old circular operation, especially high up toward the knee, answers very well. The flap method, however, is now generally preferred, from the greater ease with which it is done, and the better position of the cicatrix.

Flap amputation of the leg may be done in one of two ways: by getting a long anterior and a short posterior flap, or the reverse,—a short anterior skin flap, and a long posterior muscular one. The advantage of the former is the more ready adjustment of the edges, and the greater facility of exit for the discharges; that of the latter, the ease of performance, and the bulk and solidity of the stump when healed.

Whichever is chosen, the spine of the tibia must always be sawed off obliquely after the division of the bone, so as to prevent the pressure which would otherwise come against the soft parts in front.

Operation.—(1) *Long anterior flap.* The surgeon stands at the outer side of the right leg, at the inner side of the left, and carries an incision from a point far back on the opposite surface of the limb, downward, curving across, and then upward, so as to make a flap three-quarters as wide and long as the circumference of the limb at the point of commencement. Dividing all the tissues down to the bones, and dissecting them up, he next passes the knife behind both bones, and cuts the posterior flap about one-quarter as long as the anterior, making it full and round in shape. Next, passing a double-edged knife between the bones, he divides all the tissues at the line of junction of the flaps, and then retracting the latter, saws the bones across, dividing them at the same time. It remains only to saw off the spine of the tibia, to take up the vessels, and to bring the flaps together. *Teale's* amputation, the flaps being made rectangular, is much like this, and may be done according to the rules elsewhere laid down for it.

(2) *Long posterior flap.* The surgeon, standing as before, makes his first incision through the soft parts in front of the limb, from the posterior edge of the bone on the farther side to the posterior edge of the nearer, curving it slightly with its convexity downward; he next enters a long double-edged knife behind both bones, at the base of this incision, and cuts the posterior flap from within outward, making it of ample length and fulness. The remaining soft parts between the bones are next divided, the flaps retracted, the bones sawed through, the vessels secured, and the wound closed, as in the other method. On account of the great weight of the posterior flap, it must be very carefully supported until the healing is fully accomplished.

My own preference is for this latter method at the upper part

of the leg, and for the preceding one in the lower; having obtained the best results in this way, and having seen them occur in the experience of other surgeons.

Lateral flaps may sometimes be made in amputation of the leg, where a great saving of tissue can thus be accomplished; one long and one short lateral flap would answer the best, but the surgeon would have to be guided in any such case by the special circumstances existing. The main point would be to prevent the pressure of either bone against the upper or lower angle of the wound.

The vessels to be secured are the anterior and posterior tibials, the interosseal and peroneal.

Whatever plan is adopted, certain points must be carefully attended to. The bones must be sawn off as evenly as possible, the soft parts between them having been thoroughly divided. The saw must be made to cut through both bones at once, lest the fibula should splinter up. The spine of the tibia should be sawn off obliquely.

Amputation at the Ankle.

Surgical Anatomy.—The ankle-joint consists of the tibia and fibula above, from which project downward the internal and external malleoli; into the tenon-like cavity thus formed is received the astragalus, the lower member of the articulation. Strong ligaments at the inner and outer side reinforce the capsular covering of the joint, which is further strengthened by the tendons which surround it. The main vessels and nerves run along the back of the joint, curving under the internal malleolus to get to the sole of the foot. A smaller vessel, the *dorsalis pedis*, runs in front.

Below the astragalus, and connected with it by two distinct articulations, is the calcaneum, or *os calcis*. This bone projects backward so as to form the heel; in one form of amputation, to be presently described, this posterior portion is used in making the stump.

Operation.—*Syme's* operation, a very excellent one, is as follows:

The foot being held at a right angle with the leg, an incision is made down to the bone, from near the centre of the outer malleolus, across the sole, to the corresponding point on the inner side. This flap is then carefully dissected up, keeping the knife close to the bone, until the heel is cleared, and the tendo *Achillis* almost reached. Now, extending the foot, the second incision is made from one extremity to the other of the first, across the front of the joint, which is at once opened between the tibia and astr-

Fig. 1.



Fig. 3.

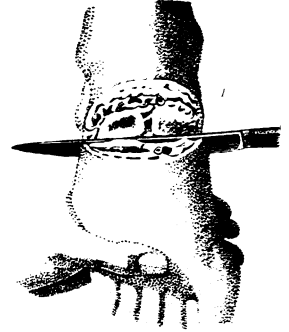


Fig. 4.



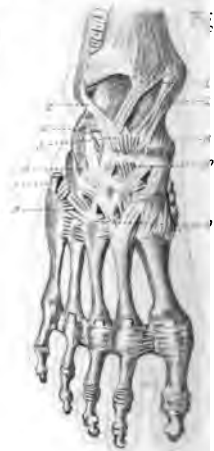
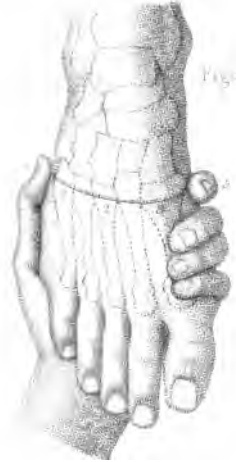
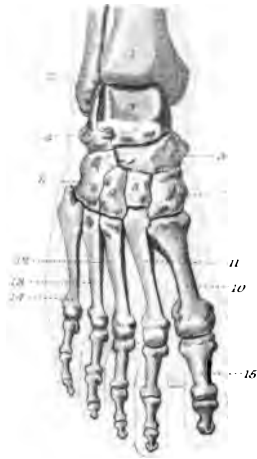
Fig. 5.



Fig. 6.



Fig. 7.



galus, the ligaments divided, and the foot separated entirely by cutting across the tendo Achillis. It remains to saw off the lower ends of the bones, protecting the soft parts by a retractor, and taking away a thin slice only. The extent of disease may oblige the surgeon to repeat this slicing once or twice, until a healthy portion of bone is exposed.

All bleeding must be completely arrested before the edges of the wound are brought together.

The main objection to this operation is that the posterior flap sometimes bags with pus, which, however, can easily be prevented by making a longitudinal slit in it, through which the ligatures are brought out.

Modifications of this operation, an external or internal flap being made instead of the posterior one, have been proposed, and may be adopted where the condition of the tissues would preclude the latter.

Pirogoff's operation differs from Syme's, in that the posterior part of the os calcis is left to be brought up against the sawn end of the tibia.

The foot being extended, an incision is made from one malleolus to the other, across the sole. Next the upper extremities of this cut are united by another across the front of the joint, which is opened, and the ligaments severed; with a narrow saw, introduced behind the astragalus, the os calcis is now divided. Drawing the heel backward, the surgeon next slices off the articulating surface of the tibia and fibula, and the operation is finished by ligating the arteries and bringing the flaps in apposition.

Excellent stumps have sometimes been obtained by this procedure; but when it fails, it fails very badly.

Amputation (disarticulation) of Portions of the Foot.

Surgical Anatomy.—In order to do any of these operations readily, the surgeon must thoroughly acquaint himself with the anatomy of the joints of this region. (See Pl. LIII, Figs. 1, 2, 4, 5, 6, 7, 8, 9, 10.) Fig. 7 shows the skeleton of the right tarsus. 1, the tibia; 2, the fibula; 3, the astragalus; 4, the calcaneum; 5, the scaphoid; 6, the cuboid; 7, the internal cuneiform, 8, the middle, 9, the external; 10, 11, 12, 13, 14, the five metatarsal bones; 15, the first phalanx of the great toe.

Fig. 8 shows the arrangement of the ligaments. 1, 1, anterior fasciculi of the tibio-tarsal. 2, external lateral. 3, 4, 5, ligaments between the astragalus and scaphoid; 6, between calcaneum and cuboid; 7, 8, between cuboid and fifth metatarsal; 9, between the cuneiform bones and the first four metatarsals.

(1) *Chopart's operation*, removing everything in front of the calcaneum and astragalus.

Anatomy.—(Fig. 1, Pl. LIII.) 1, the astragalus; 2, the calcaneum; 3, the cuboid; 4, the scaphoid. The prominence formed at the inner side of the foot by the scaphoid bone is seen at 5, the position of the articular line externally at 6. *a* and *b*, pins introduced to show the direction in which the joint may be entered.

Figs. 5 and 6 show lateral views of the tarsus. Fig. 5, outer side; 1, calcaneum; 2, cuboid; 3, 4, pins introduced to show the direction in which the joint is to be entered. Fig. 6, inner side; 1, astragalus; 2, scaphoid; 3, 4, pins in the joint.

Operation.—The foot is extended, and the heel grasped in the surgeon's left hand, the thumb and forefinger of which are placed firmly over the scaphoid and cuboid bones. A slightly curved incision is now made (Fig. 2, 1, 2, 3) across the front of the joint, beginning just above the thumb and ending at the opposite point, just above the forefinger. The short flap thus described is turned up so as to admit of the joint being opened; when the surgeon, bearing the foot strongly downward, passes an amputating knife, as in Fig. 3, behind the scaphoid and cuboid bones, and makes the posterior flap of the soft parts of the sole, cutting close to the bones, and bringing the knife out just below the heads of the metatarsal bones. (See Fig. 4, Pl. LIV.)

(2) *Sédillot's operation* is also through the astragalo-scaphoid and calcaneo-cuboid joints, but the incisions are made as follows:

Operation.—The surgeon, extending the foot in the grasp of his left hand, enters his knife about half an inch in front of the calcaneo-cuboid joint, and carries it across the back of the foot, to near the outer margin of the tibialis anticus tendon. From this point another incision is made, forward and inward, then down the inner side of the foot about two fingers'-breadths from the metacarpo-phalangeal joint of the great toe, across the sole of the foot, and then upward to the original point of starting. The tissues on the sole of the foot are cut somewhat obliquely, so as to favor union. Dissecting up these flaps, the joint is found by means of the prominence of the scaphoid, and the ligaments divided.

Lisfranc's operation, through the tarso-metatarsal articulation, is a very good one.



Fig. 3.



Fig. 8.

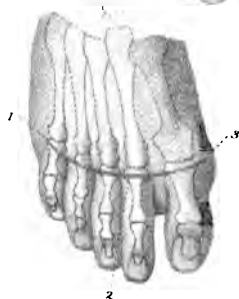


Fig. 10.

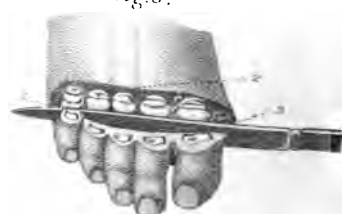


Fig. 12.



Anatomy.—The three first metatarsal bones articulate with the cuneiform bones, the second being wedged in between the internal and external cuneiform. The first and fifth metatarsals form salient points at the inner and outer borders of the foot, by which the position of the joint can be recognized.

Operation.—The surgeon grasps the foot in his left hand, marking the prominences of the first and fifth metatarsals with his thumb and forefinger. He then makes a somewhat curved incision across the dorsum of the foot, beginning and ending just below the points indicated (Pl. LIII, Fig. 9, 1, 2, 3). Dissecting up this flap, he next enters the joint, divides the dorsal ligaments all across (Fig. 1, Pl. LIV), pushing the tip of the knife down between the head of the second metatarsal and the middle cuneiform bones, and then, as in Fig. 10, Pl. LIII, inserting it between the former and the adjacent metatarsals and making it cut the lateral ligaments by moving the handle in the arc of a circle, 1, 2, 3. Having thus freed the bones, he bears the foot strongly downward, divides all the fibrous structures, separates the bones completely, and passes in the amputating knife so as to cut, from within outward, the inferior flap, which should consist of all the soft parts of the sole. (See Fig. 2, Pl. LIV.) The knife cuts its way out just at the roots of the toes, and the operation is completed. The wound thus made is shown in Fig. 3, Pl. LIV, which may be compared with Fig. 4, representing the wound in Chopart's operation.

Amputation through the metatarsal bones may be readily done, by making a slightly curved incision across the dorsum of the foot, pushing a double-edged catlin across beneath the bones, and cutting out the inferior flap as far as the root of the toes. A six-tailed retractor is now applied to keep the soft parts out of the way while the bones are sawed across (Fig. 5, Pl. LIV). The resulting wound is shown in Fig. 6.

Disarticulation of all the toes is shown in Figs. 7 and 8, Pl. LIV. The flaps are made, as long as possible, above and below.

Disarticulation of single toes may be done just as in the case of the fingers (Fig. 10, Pl. LIV). An oval incision is shown at *a*; the method by lateral flaps, at *b*.

Excision of the first metatarsal bone may be done as in Fig. 11, Pl. LIV, by making a curved incision, 1, 2, 3, exposing the upper or tarso-metatarsal joint, dividing the lateral liga-

ments, turning the bone out and separating it from the soft parts, and then in like manner cutting through the metatarsophalangeal ligaments.

Removal of the great toe with its metatarsal bone may be done just as in the case of the thumb and its metacarpal. Fig. 12, Pl. LIV, shows the incision, 1, 2, 3, 4, along the metatarsal bone and around the toe.

CHAPTER XII.

OPERATIONS FOR NÆVUS; FOR VARICOSE VEINS; OPENING OF ABSCESSSES AND SINUSES; TRANSFUSION OF BLOOD; DUTIES OF ASSISTANTS IN SURGICAL OPERATIONS.

§ I. OPERATIONS FOR NÆVUS.

Nævus, or mother-mark, is a vascular spot, sometimes congenital, but more commonly appearing a month or more after birth; it may be a mere stain-like discoloration, or involve the whole thickness of the skin, in which case it forms a prominence above the level of the surrounding surface. There may be but one spot, or there may be several; and they may occur on any portion of the body. As to color, these spots vary from a bright red to a deep purple; when the child cries, they become greatly congested, especially if on the face. In structure, they are composed mainly of dilated blood-vessels, with some hypertrophied areolar tissue.

All these points must influence the surgeon in his choice of a plan of treatment. If the growth is small and seated on a part not exposed to sight, and shows no disposition to increase, it may be let alone. But in almost any situation, if the disease is spreading, it ought to be effectively dealt with. Several plans of operation have been proposed, the chief of which are: vaccination, injection, cauterization, ligation, and exsection.

Anæsthesia is not necessary in children under two or three years of age, on whom these operations are generally done.

Operation.—(1) *Vaccination.* This may be done either by the ordinary plan, scoring the skin over the nævus and applying the lymph or the scab softened in water, or by saturating a silk thread with the softened scab, and passing it through the growth. The latter plan I have found perfectly successful in small and superficial nævi.

(2) *Injection.* With a small hypodermic syringe, a few drops of a strong solution of perchloride of iron, or nitrate of silver, may be injected into the substance of the nævus, which becomes

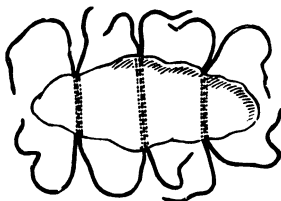
inflamed, and either shrinks away, or suppurates. Of course this may be repeated at different points, if the growth is of large size, and if the first operation fails to act upon the whole of it. (Fatal results have been met with from the injection of *nævi* on the face or neck; and it would be safer, even in the extremities, to occlude the veins at the cardiac side of the growth by pressure, for a short time,—a quarter of an hour at least,—after the throwing in of the fluid.)

(3) *Cauterization.* This may be done either with the actual cautery, or with nitrate of silver. An ordinary cauterizing iron may be lightly applied at a white heat; or if the *nævus* be very small, several heated needles may be thrust through it.

Or, a broad needle or very narrow bistoury may be passed into the little tumor, withdrawn, and a probe coated with nitrate of silver inserted in the orifice. This also can be done at several points if desired. Should troublesome hemorrhage ensue, the surgeon may at once resort to the ligature, to be presently described.

(4) *Ligation.* Sometimes the vascular mass is pediculated, when a silk thread may be tightly tied around its base. When it involves the skin, two needles may be thrust under it, at right angles to one another, and a thread tied around them so as to strangulate the vessels. If the *nævus* be of irregular shape, it will sometimes be necessary to pass several needles, and to tie the silk thread around them all. In the case of an irregular or elongated *nævus*, a ligature may be applied as in Fig. 139. A

Fig. 139.



needle is armed with a very strong thread, and carried across the base of the growth near its end; the thread is then cut at the eye of the needle, and one of its ends taken up, and carried across again, to be again cut at the eye of the needle. This may be repeated as often as necessary, until the whole mass can be

strangulated by knotting together two of each three pair of ends, and strongly drawing the third pair, which may then be tied.

(5) *Exsection.* Usually there is no vessel of any size going to a *nævus*; and hence, by making slight pressure, incisions may be made around it, the whole mass removed, and the bleeding readily checked.

Another plan is to pass two or more needles across under the growth, entering them and bringing them out about one-eighth of an inch from its margins; then to excise it, and close the wound at once by applying a thread over the needles as in the ordinary harelip suture.

Whichever of these plans is used, except the first, a very simple protective dressing, such as lint dipped in cold water, or a piece of soft rag spread with cerate, should be put on, and secured with a few adhesive strips. When the part will be covered by the clothing, the latter form of dressing is best, for obvious reasons.

§ II. OPERATION FOR VARICOSE VEINS.

Dilatations of the superficial veins of the lower extremity are sometimes so troublesome, from painful pressure on nerves, from preventing the healing of ulcers, or from the risk of their bursting, as to justify an operation for their obliteration.

Operation.—Anæsthesia is hardly necessary.

A harelip pin is passed through the skin, dipped clear under the vein, and brought out on the other side; the points of entrance and exit being about a quarter of an inch from the enlarged vessel. (Care must be taken not to wound the vessel.) This being done at several points half an inch to an inch apart (the upper pin being the first inserted), bits of bougie are laid over each pin, parallel with the vein, and silk threads tied in a figure-of-8 over the ends of the pin, between which and the bougie the vein is compressed and occluded. In five or six days the threads may be cut, and the pins drawn out. A bandage or an elastic stocking should be worn for some time afterward. It is obvious that this plan is very analogous in principle to that of acupressure, described at p. 25.

§III. OPENING OF ABSCESSES AND SINUSES.

A few words may here be said on these very common operations, which are not always done in the right way. Anæsthesia being hardly ever deemed necessary, the patient is saved much pain by the use of instruments which are in perfect order, and by executing the manœuvre as instantaneously as possible.

Abscesses.—(1) When an ordinary superficial abscess is to be opened, the surgeon should steady the part with his left hand, while with his right he plunges a sharp-pointed curved bistoury through the wall of the abscess, depresses the handle so as to carry the point on as far as he deems proper, thrusts it up and out through the skin by further depressing the handle, and completes the cut by raising the instrument. All this is done almost at the same moment, the hand being steady but free, so that no harm can occur if the patient should start.

(2) For the opening of a bubo, it is sometimes better to give an anæsthetic, since there are often several blind pouches to be followed up, and the patient's courage may fail after the first cut is made.

(3) To open a deep abscess, a point is selected where no important vessels or nerves will be wounded; a straight sharp-pointed bistoury is thrust in perpendicularly to the skin, and rotated a little on its long axis, when, if the cavity is reached, the pus will well up alongside of it; the muscular and other deep-seated tissues may now be divided by cautiously moving the blade to and fro. If there is any difficulty in reaching the abscess, from the risk of doing injury with the knife, a pair of dressing forceps may be inserted in place of it, and the blades expanded steadily but gently, so as to prepare a way for the escape of the pus.

(4) When, as in the case of psoas abscess, or of suppuration in the cavity of a joint, it is desirable to make a valvular opening, a fold of skin may be pinched up, and a straight sharp-pointed bistoury thrust nearly through its base; then by raising the handle of the instrument its point may be brought into position to be pushed on into the cavity of the abscess, and upon withdrawing it, a track or sinus will be left for the discharge of the matter.

A practice which is often followed, but which is both useless and painful, is to squeeze out the cavity of an abscess. Time is

not gained by this, but lost. It is far better to use the very gentlest compression continuously, than to thoroughly force out a quantity of pus once a day, only to be reformed by the bruised and irritated walls. In large cold abscesses, indeed, the gravest consequences may ensue upon their being either abruptly emptied or roughly handled.

(5) If a seton is to be used, or a drainage-tube (a slender tube of india-rubber, its walls perforated with numerous holes), we may either pass a long and strongly curved needle into the abscess and out of it at the desired points, drawing it through with its thread, to which may be attached the seton or tube; or we may make two openings with a bistoury, and then carry through them both an eyed probe, as a substitute for the needle.

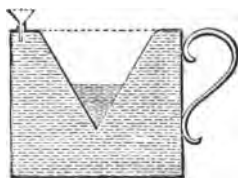
Sinuses.—The only direction which need be given for the laying open of sinuses is that it should be freely done, with a very sharp-edged bistoury. If the point of the knife is sharp, a grooved director is usually needed as a guide for it; if it has a probe-point, it may be made to find its own way.

§ IV. TRANSFUSION OF BLOOD.

This very important procedure, the injection of fresh blood into the body, has been several times done by Dr. J. G. Allen, of this city, within the past year or two, in cases of extreme exhaustion from hemorrhage. In one case I am informed that it was a perfect success; in two others the benefit derived was only temporary, death ensuing from other causes.

Operation.—Anæsthesia is obviously out of the question in almost all the cases requiring this procedure.

Fig. 140.



The instruments necessary are: a glass syringe of about fʒiv capacity, in perfect order, with a needle-pointed tube like that of the small hypodermic syringe, but larger, and a cup such as

is shown in section in Fig. 140, for holding the blood to be injected. The cup is double, the outer portion being filled with water at a temperature of 105° Fahr., by means of the opening at the edge; the inner portion is of conical shape in order to the easy reception of the blood, and filling of the syringe with it without waste. The blood being drawn from a healthy person, is whipped with a little bunch of twigs (a piece of a whisk or broom answers very well) so as to separate the fibrin, and quickly strained through a piece of fine clean old linen, into the cup. The syringe, thoroughly warmed, is next filled from the cup, and fitted to the tube, which is then thrust into one of the veins of the forearm of the sick person, the vein being made prominent by pressure above, as for the operation of bleeding. The tip of the needle point being brought into the axis of the vein, the piston is slowly pushed, and the whole of defibrinated blood gently added to that in the venous system of the patient. As the instrument is withdrawn, the finger-tip is placed over the orifice, and kept there for a few minutes.

As many charges of the syringe may be inserted as the surgeon may deem necessary, at the same or different points.

§ V. DUTIES OF ASSISTANTS IN SURGICAL OPERATIONS.

Different operators vary much in their relations to their assistants. Some surgeons prefer doing nearly everything for themselves; others confine their attention to the chief steps, leaving all the minor arrangements to their subordinates. Again, there are some operations in which the assistance of a number of qualified persons is essential. But in all cases, the surgeon should know what aid he can count upon, and let those who are to help him understand just what they are expected to do. For obvious reasons, if a surgeon operates much, he will find it convenient to have one or more assistants who are familiar with his methods and preferences, and with whose capacities he is himself acquainted, upon whom he can call at any time.

It may seem scarcely necessary to say that when an operation is in course of performance, there should be no conversation going on among the assistants or bystanders. It not only distracts the attention of those who have duties to perform, but annoys and disturbs the coolest operator. Upon this point the

surgeon has a right to insist, and in justice to his patient as well as himself he should do so without hesitation.

Whenever anæsthetics are given, one person should have charge of their administration. He should inform himself from time to time of the state of the pulse, and should carefully watch the respiration. It is well also for him to examine occasionally the state of the pupils. As soon as anæsthesia is thoroughly induced,—as shown by the non-contraction of the eyelids when the conjunctiva is touched,—he should announce the fact distinctly to the surgeon.

In giving ether or chloroform, the assistant should stand behind the patient's head, grasping it between his spread hands, and holding the sponge, towel, or handkerchief in place with his thumbs; the complete control of the head, given by this means, adds greatly to the convenience of all concerned.

Sometimes all the arrangements for an operation are intrusted to an assistant. He should look first to the preparation of a convenient operating-table. (See page 18.) A piece of ordinary floor oil-cloth, oiled silk, or india-rubber cloth, should be so placed as to protect the bed or mattress from being soiled by blood or other discharges. Upon the floor, for the same purpose, an old carpet or blanket should be laid down.

Due consideration must be given to the placing of the table so that the light shall fall properly. A skylight is best, if it can be had. The arrangement of the necessary instruments, the temperature of the room, etc., have been elsewhere discussed.

Certain classes of operations involve special duties for the surgeon's assistants.

In *amputations* one great point is to avoid the unnecessary loss of blood. Hence the assistant who is intrusted with the putting on of the tourniquet should first raise the limb up, and pass his hand repeatedly along it from the distal extremity toward the trunk, with firm pressure, so as to empty it as much as possible of venous blood. The tourniquet should now be adjusted, so as to command the artery; it may then be loosened somewhat, until the anæsthesia is complete and the operation is about to be begun, unless there is actual hemorrhage to be controlled.

As soon as the severing of the limb is accomplished, the operator generally brings the edges of the wound together, to

assure himself that he has provided a good covering for the end of the bone. Next, the wound is again allowed to fall open; any arteries which are plainly seen are secured, whether by ligation or by acupressure, and then the pressure of the tourniquet is gradually relaxed so as to permit the swollen vessels to be detected by the flow of blood from them. Some surgeons pick out the vessels themselves, and have the ligatures or acupressure applied by an assistant; others prefer to reverse this arrangement. Others again put the wound altogether in charge of their assistants, only exercising a general oversight of the process of dressing.

The vessels are detected by watching for the flow of blood from them, then by a quick and firm pressure with a damp sponge leaving the surface clean, when they are instantly sought for and caught either with the tenaculum or forceps. Hence the assistant having charge of the sponges ought invariably to wring them out before handing them for use.

The control of hemorrhage in special amputations has been spoken of in connection with each case.

In *lithotomy*, the most important assistant is the staff-holder. His duties have been elsewhere fully detailed. The same may be said of the functions of assistants in operations on the eye and other parts.

Tact and experience are required, as well as a familiar acquaintance with the objects and steps of the operation to be performed, to make any one a thoroughly good assistant. Everything should give way to the accurate fulfilment of the duty, simple and subordinate as it may be, to which each assistant has been assigned. In case of anything going wrong, it is the business of the surgeon to see to it, and to direct whatever changes of plan or of detail may be indicated.

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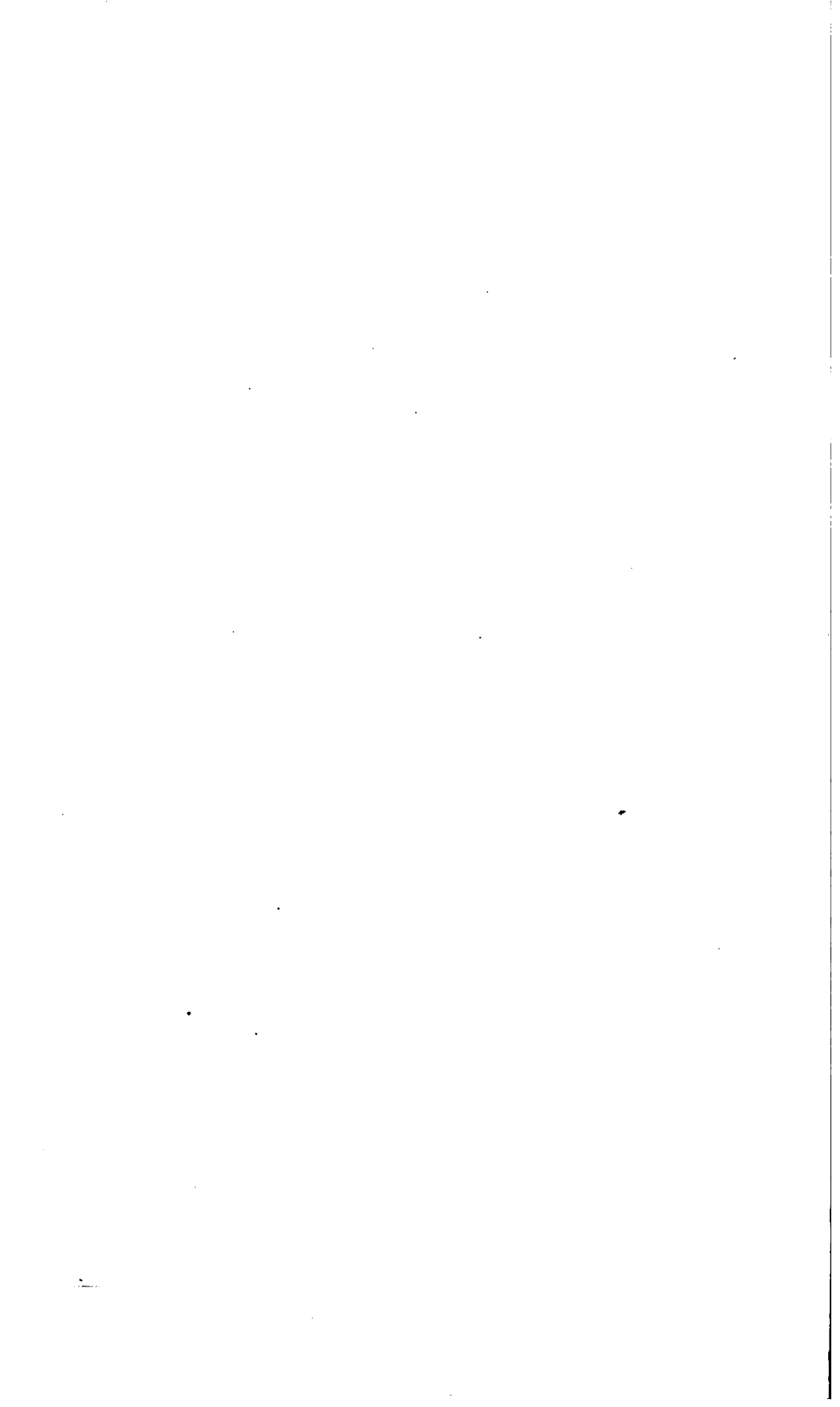
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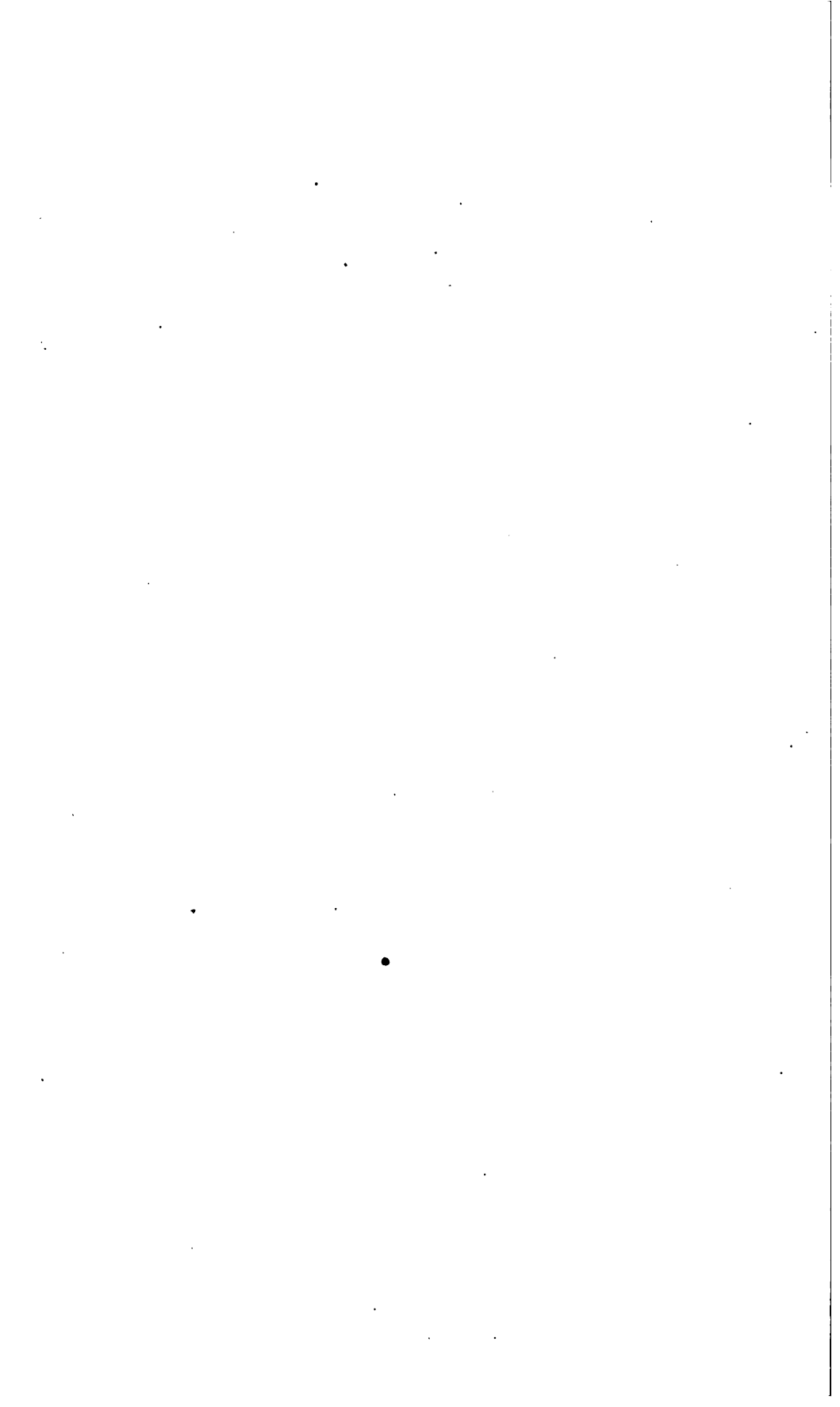
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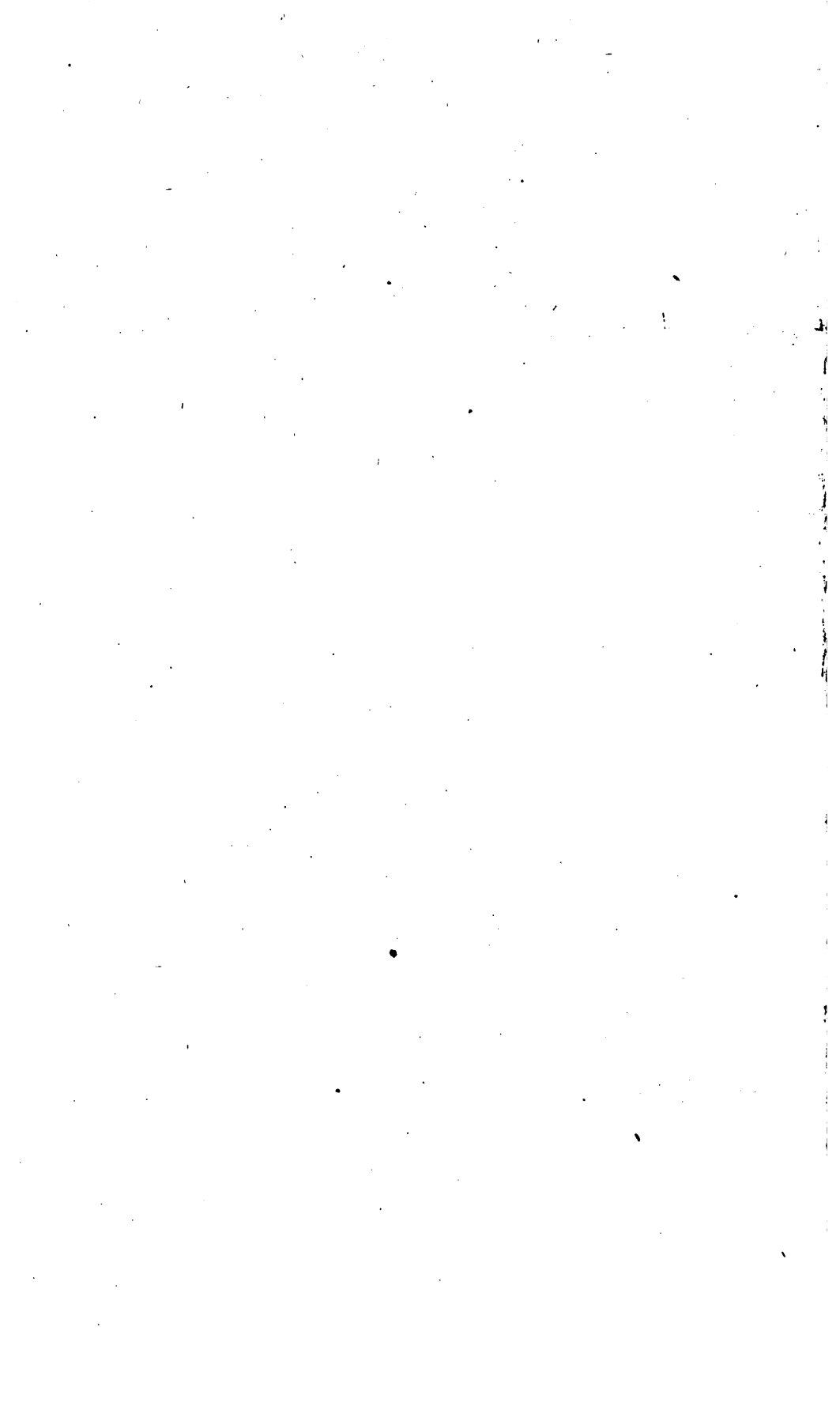
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